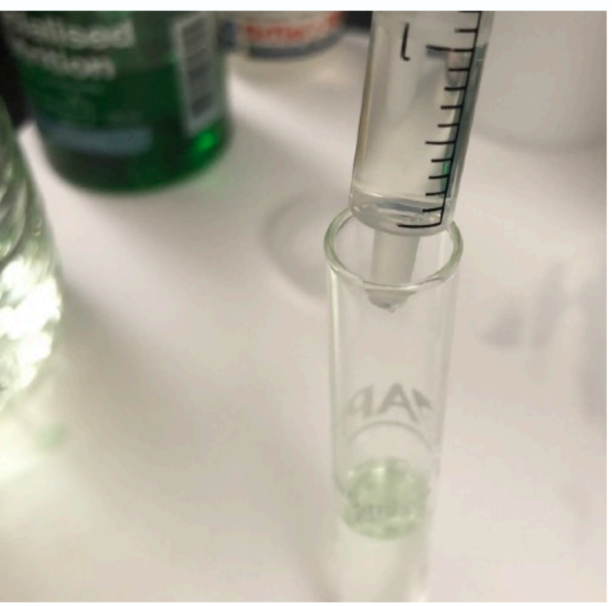
Ashank Singh

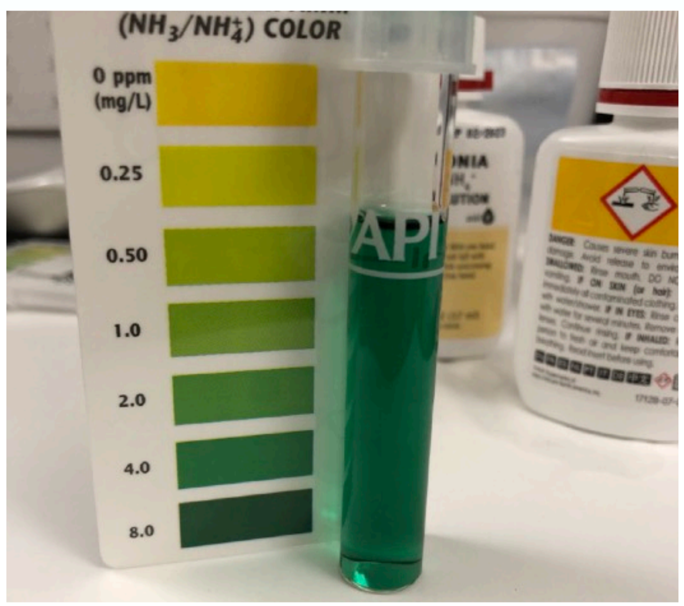
Portfolio

FISH BUDDY

Fish-keeping, Simplified.

BACKGROUND



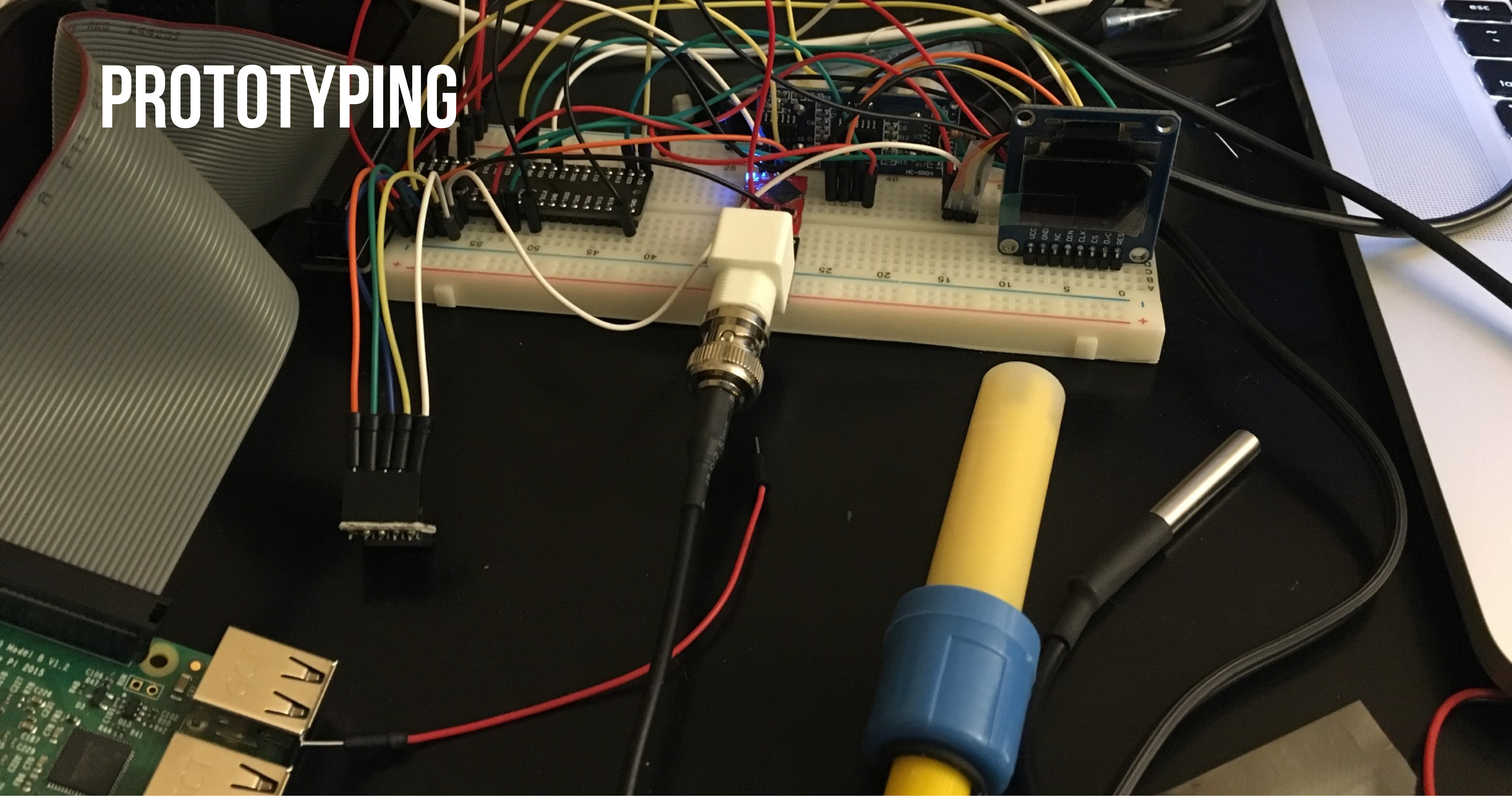


Aquariums are delicately balanced microecosystems.

pH, temperature, TDS (total dissolved solids), nitrate, and ammonia are a few parameters that aquarists frequently monitor.

Unchecked parameters can spell disaster for aquarium inhabitants. Emergency maintenance can quickly drive up costs in the aquarium hobby and in the $15 billion aquarium industry.

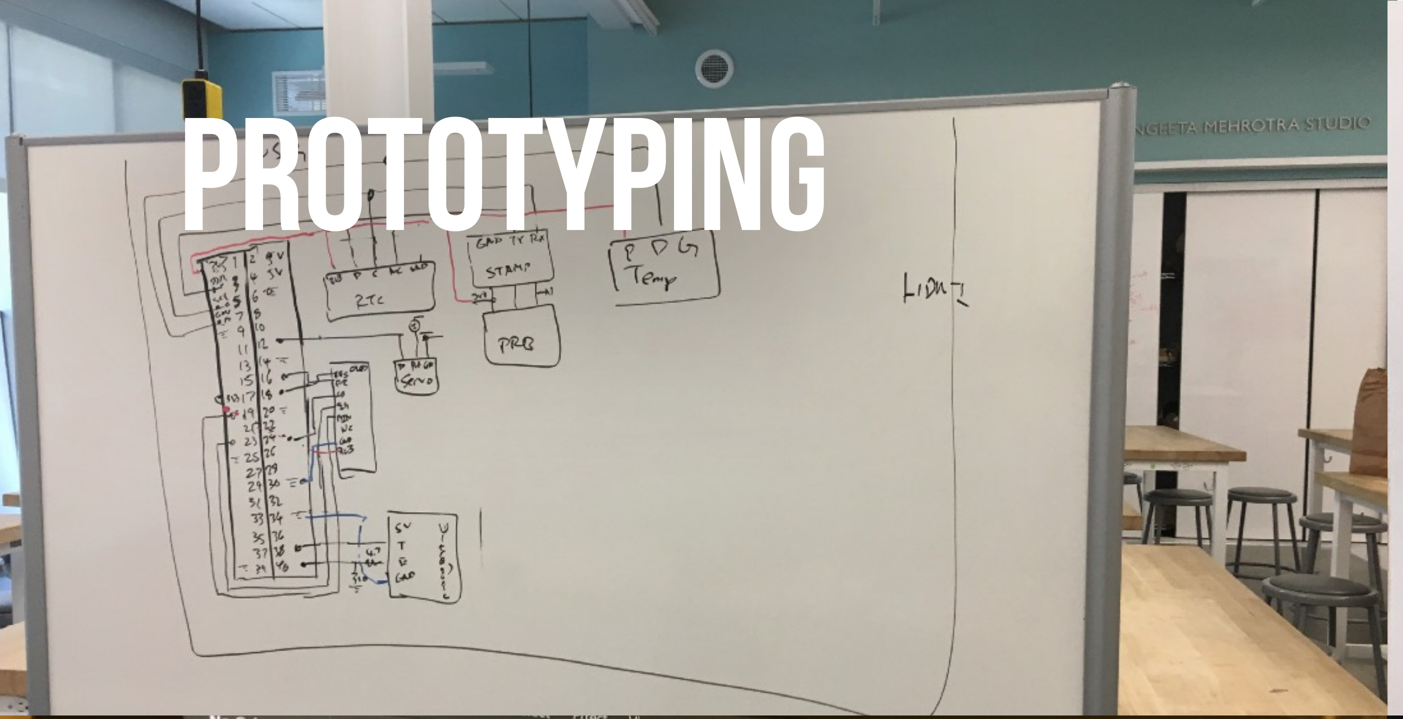
PROTOTYPING

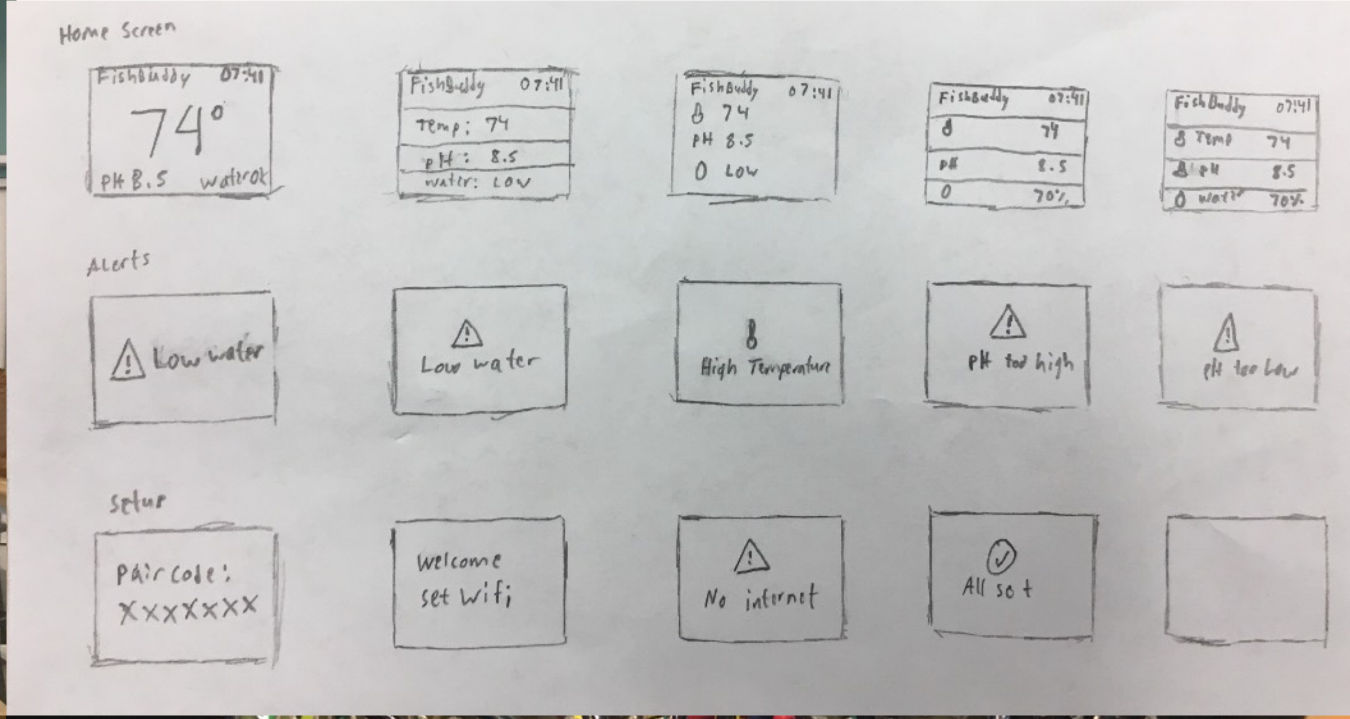


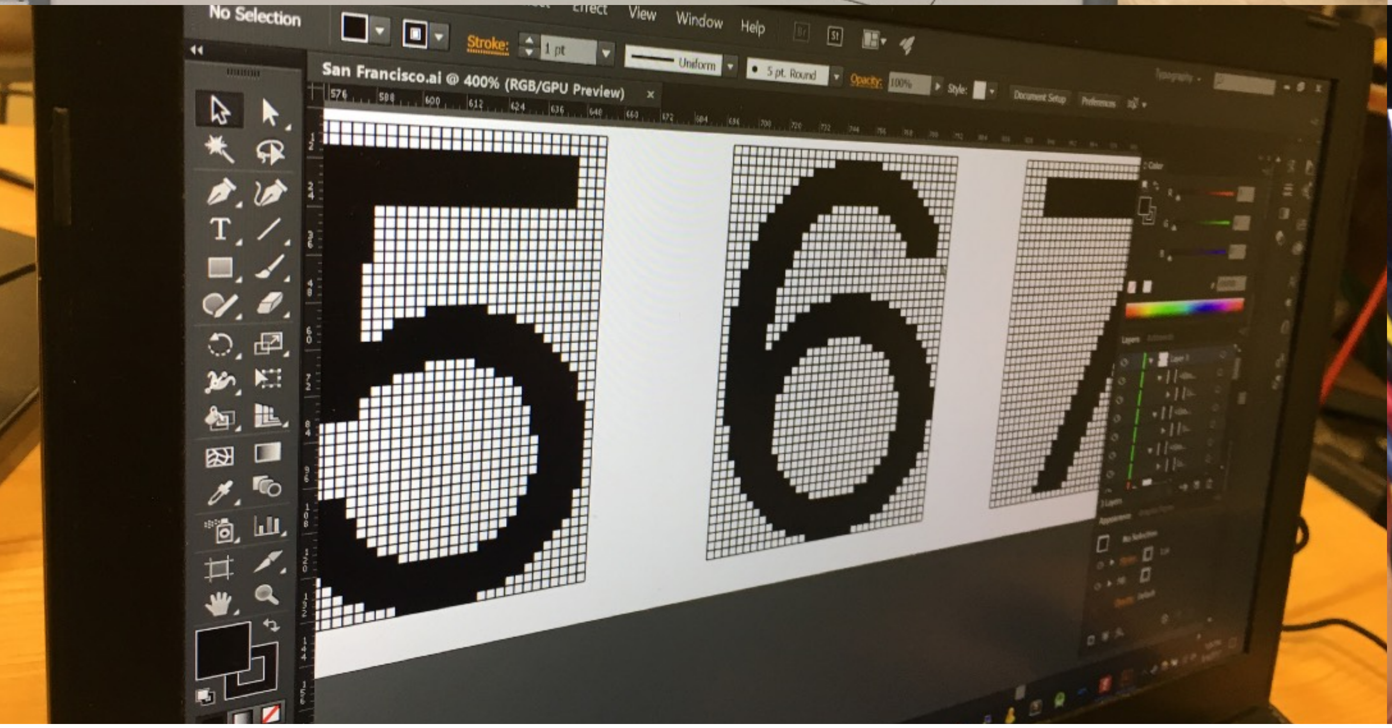
Following two weeks of evaluating user needs, a cloud-connected approach to monitoring aquariums was necessary.

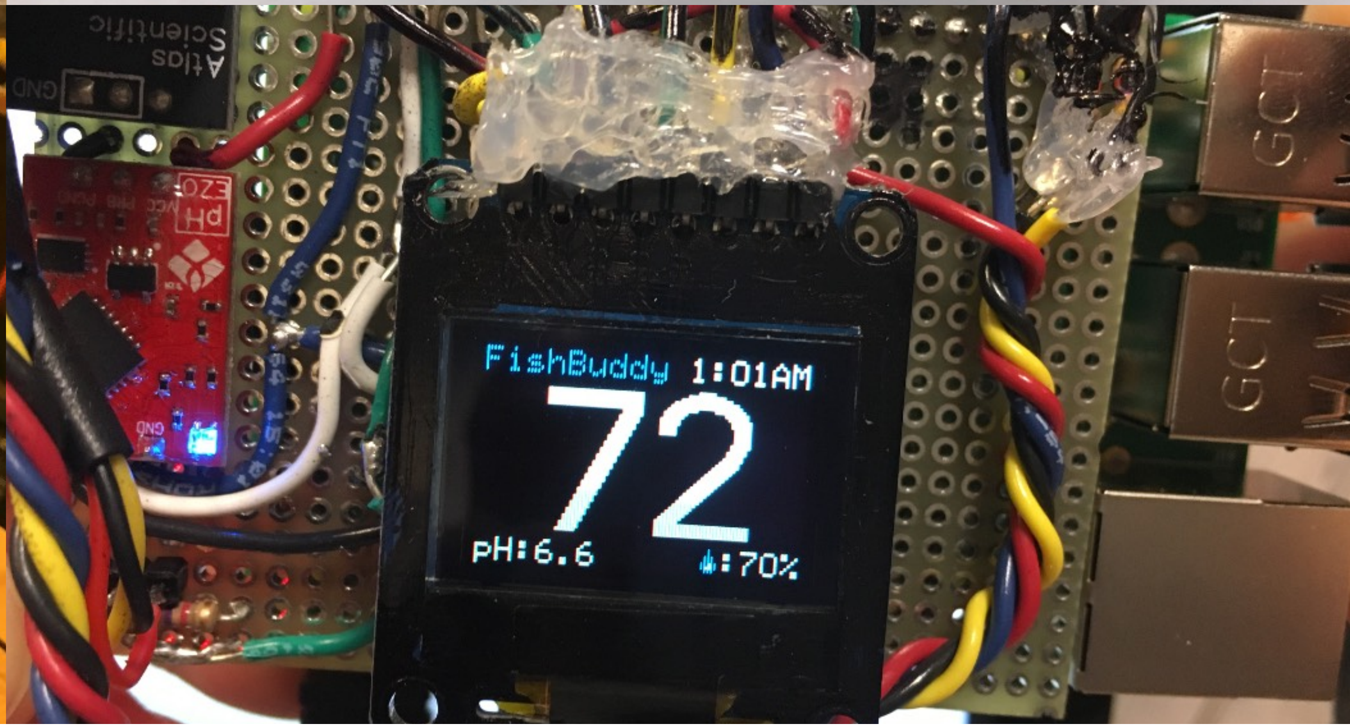
Later prototypes incorporated a Raspberry Pi, a real-time clock, an OLED display and a number of lab-grade sensors.

PROTOTYPING



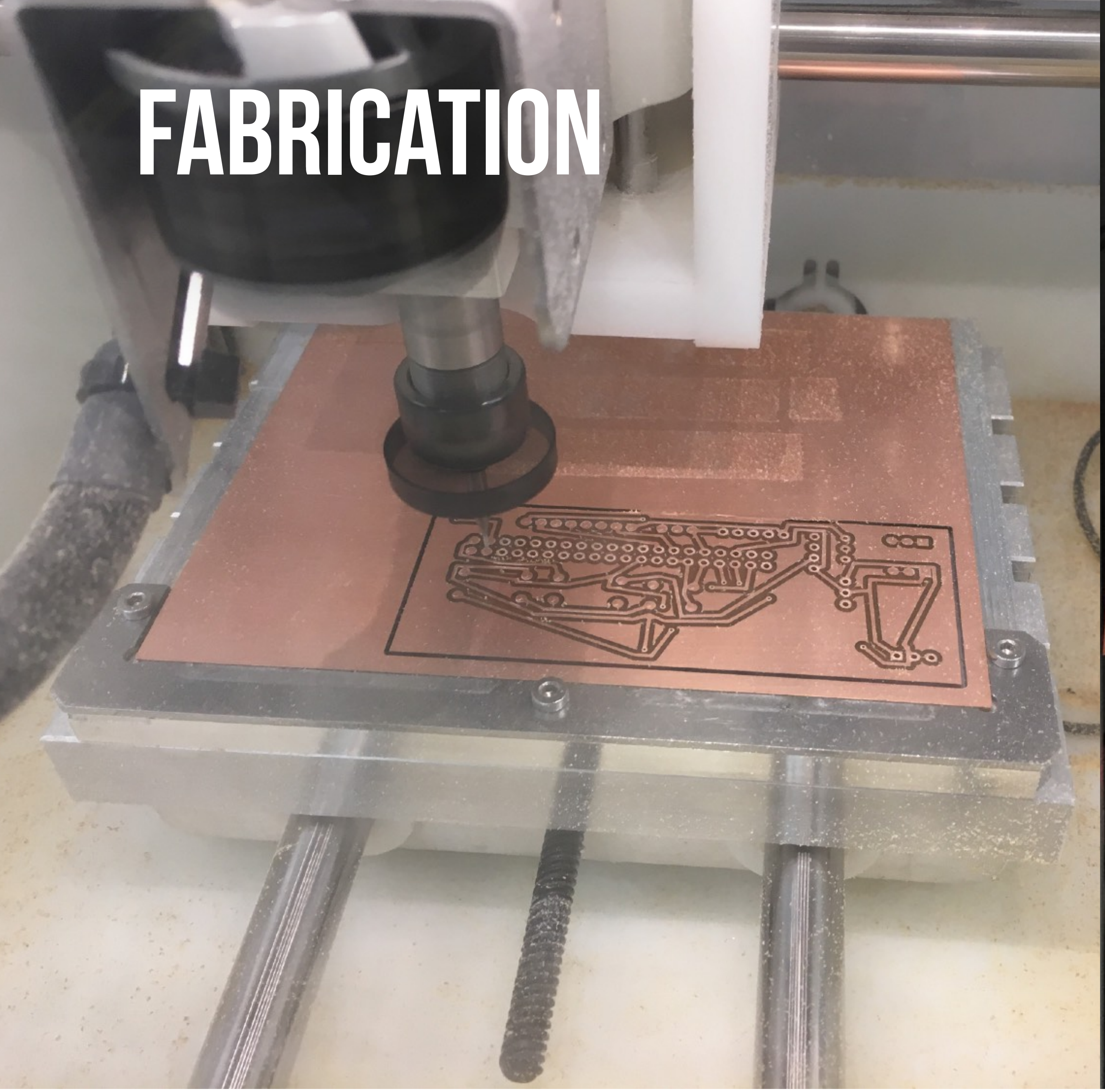






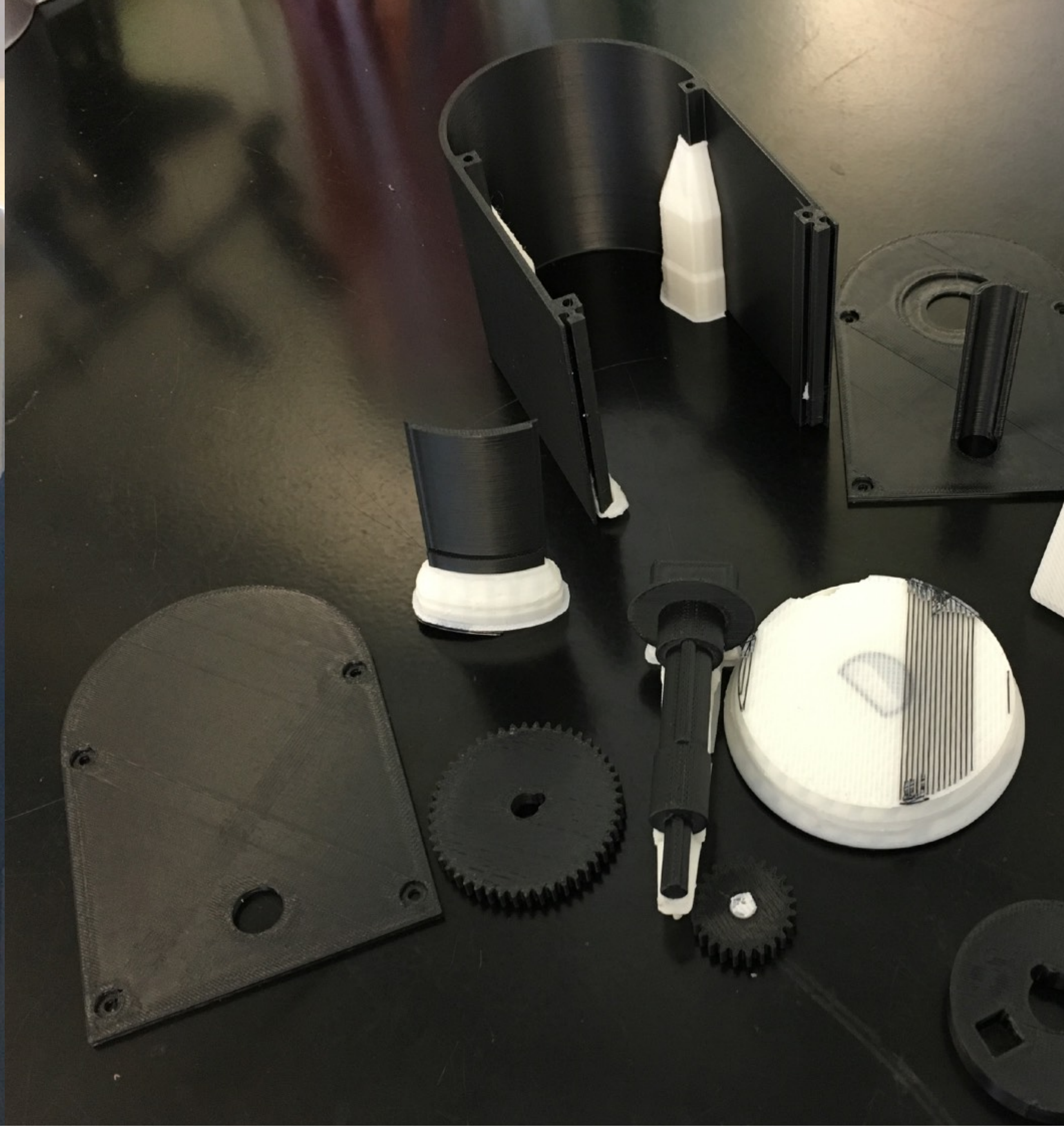
Careful design considerations had to be made. Incorporating a 1 inch OLED display required working around its 128 x 64px resolution. The readability issues were addressed by designing a an optimized user interface and a custom sans-serif font: FishBuddy Sans.

FABRICATION



Near the final stages of prototyping, it became necessary to transition from hand-routed perfboards to PCBs which were CNC-milled to the exacting requirements of the final enclosure.

FABRICATION



Meticulous attention to detail was necessary. Precision components requiring tolerances of ± .127 mm were fabricated using a Stratasys Fortus 380mc. Gears, shafts, and the enclosure for the feeding mechanism were 3D printed in this manner.

FINAL FORM

FishBuddy packages a server and real-time monitoring system in a 4.8 x 3.5 in laser cut black box. A precision feeder with an adjustable output slider ensures fish are fed only as much as they need. Ultrasonic sensors underneath the feeding drum monitor water levels and detect leaks.

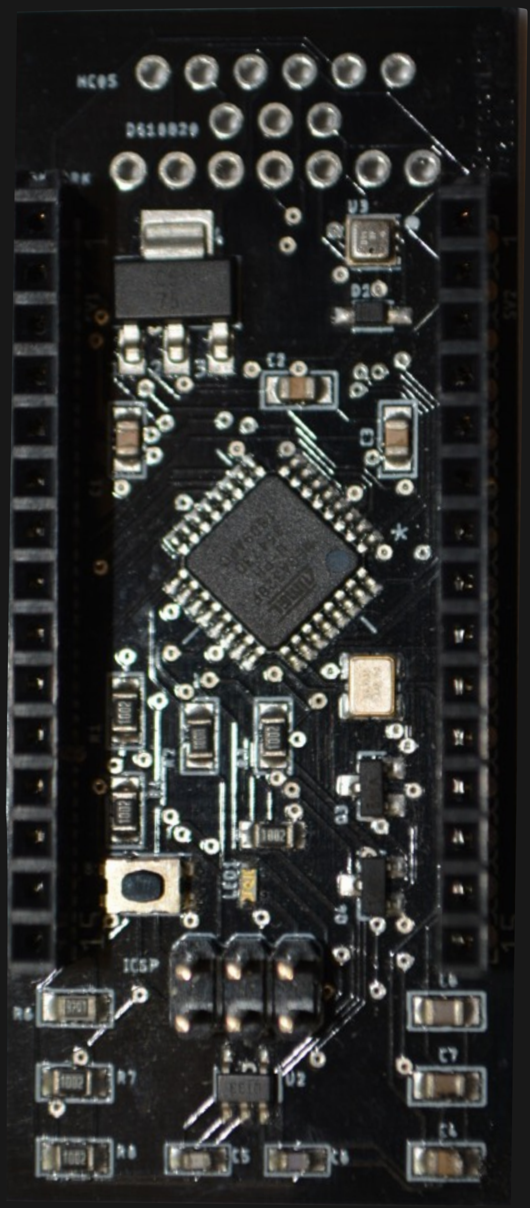
AN ECOSYSTEM IN HARMONY

FishBuddy features three different components that seamlessly work together to automate feeding and water parameter monitoring. With the FishBuddy app users can see their tank's vitals in realtime and can customize FishBuddy to suit their needs.

FISH-KEEPING, SIMPLIFIED.

FishBuddy addresses problems associated with fish-keeping by monitoring the root cause of them all: water quality.

In many ways, FishBuddy is the ultimate intersection of nature and technology.



SENSORLINK

BACKGROUND

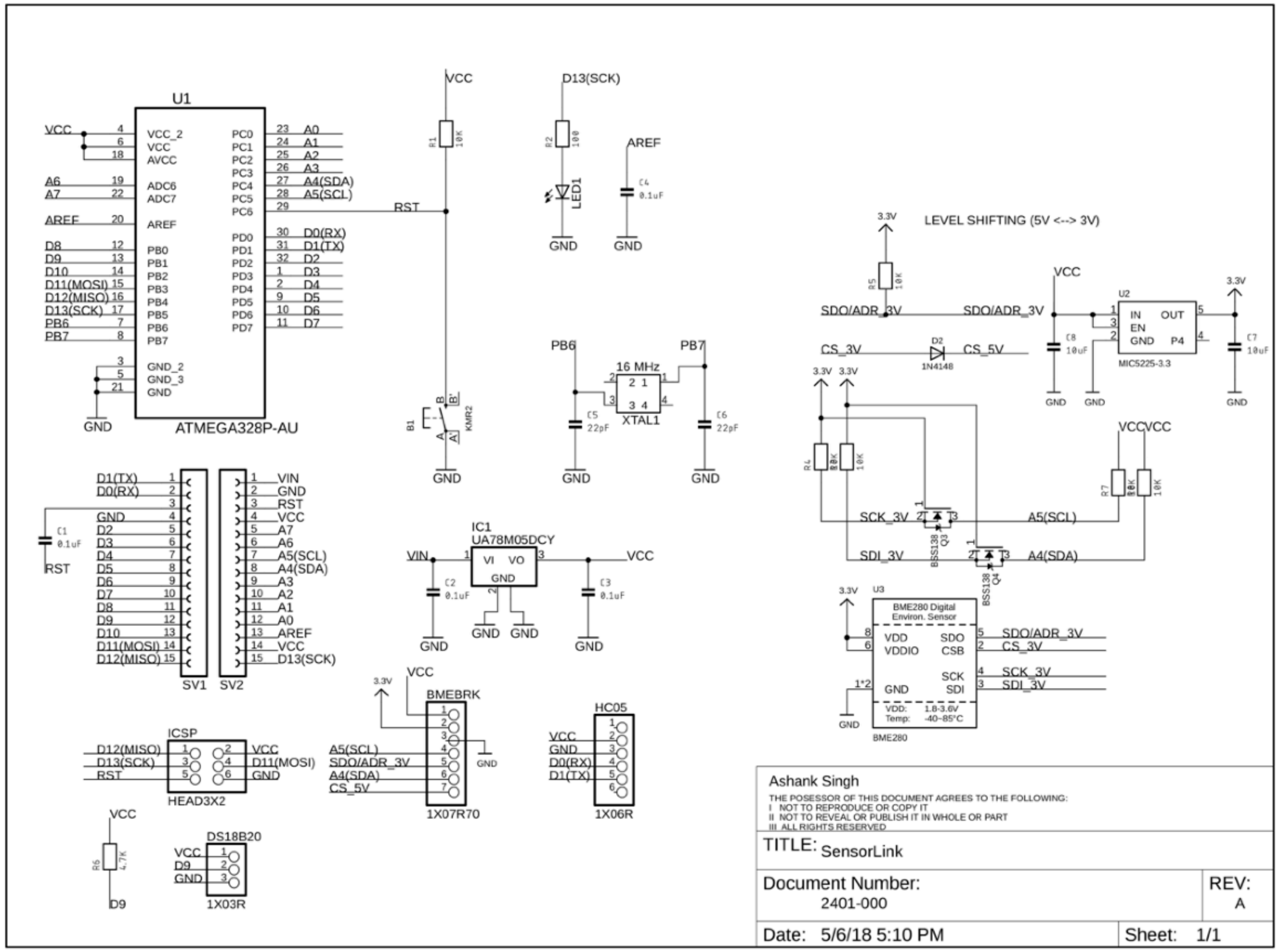
Smart thermostats bridge HVACs with the digital world and use aggregated data to make decisions that reduce energy consumption.

Frequently, less than ideal placements of vents make certain rooms less comfortable than the other rooms in buildings.

Current thermostats on the market only consider the room's temperature and fail to account for the humidity of each room.

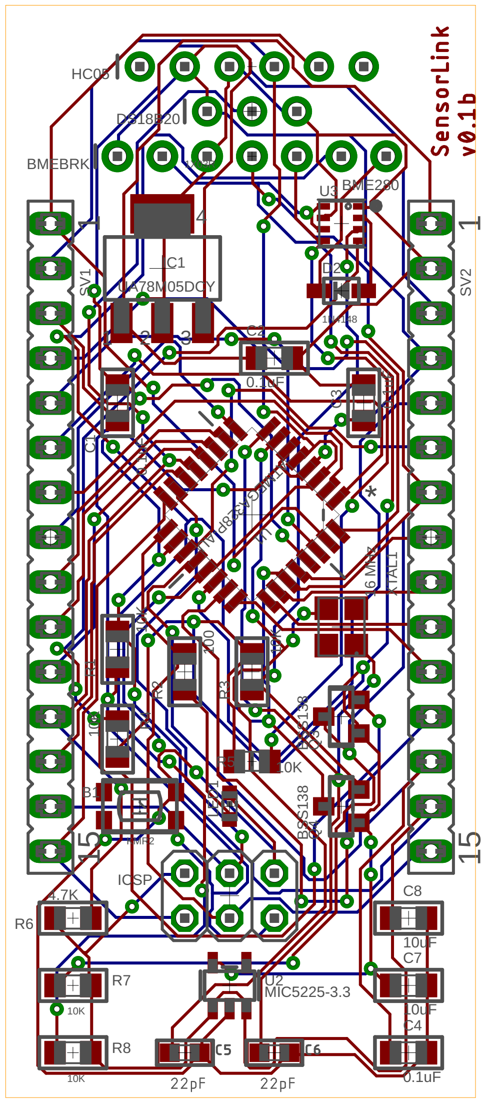
Clearly, there needs to be a way to augment existing thermostats with humidity data from each room!

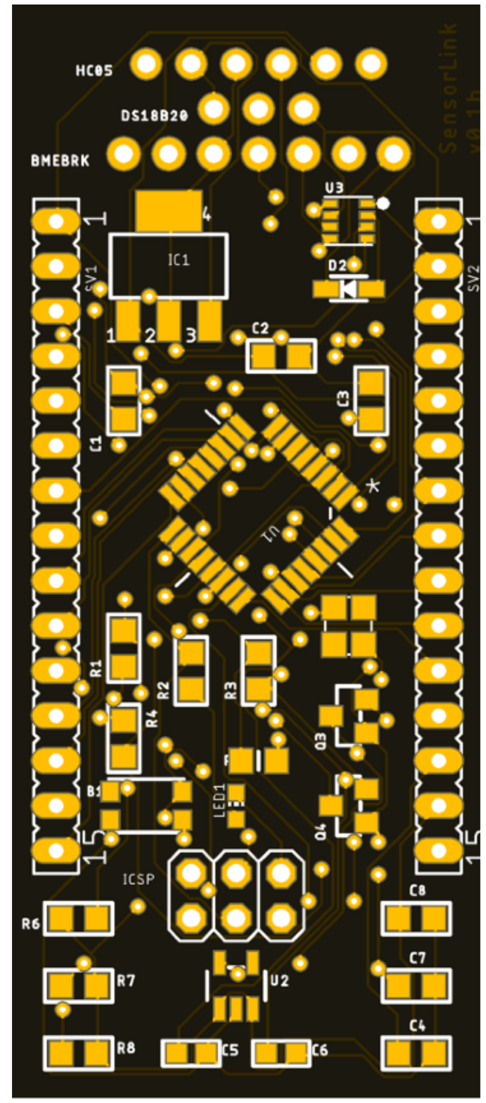
DESIGN

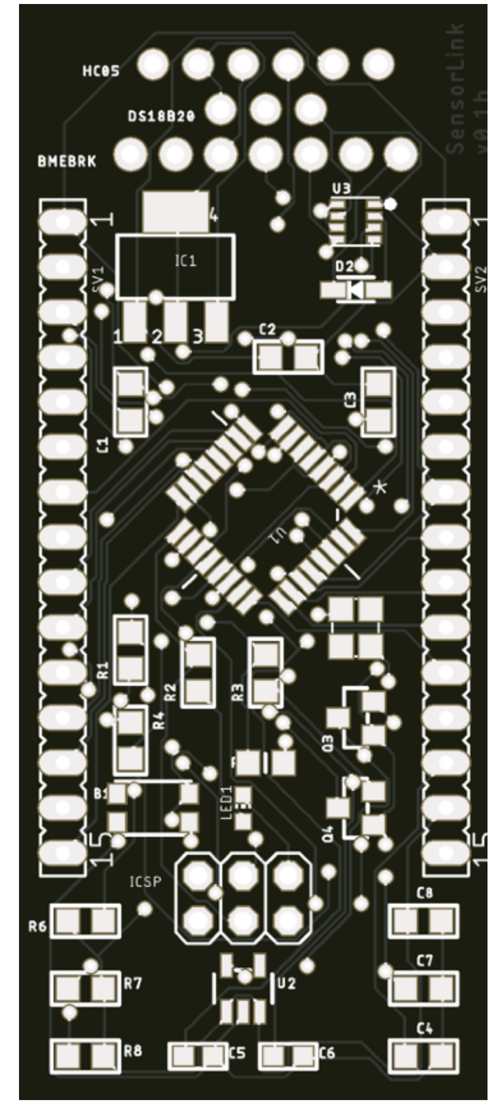


Simply put, all wireless sensors comprise of a MCU, a battery, a sensor, and a radio of some sort. After disassembling and evaluating the components of wireless temperature sensors as well as an iPhone 6S, I discovered the degrees to which sensors are miniaturized and set out to design and build my own board. I chose the Bosch Sensortech BME 280 and worked my way up to build a board capable of augmenting thermostats with additional humidity data.

DESIGN

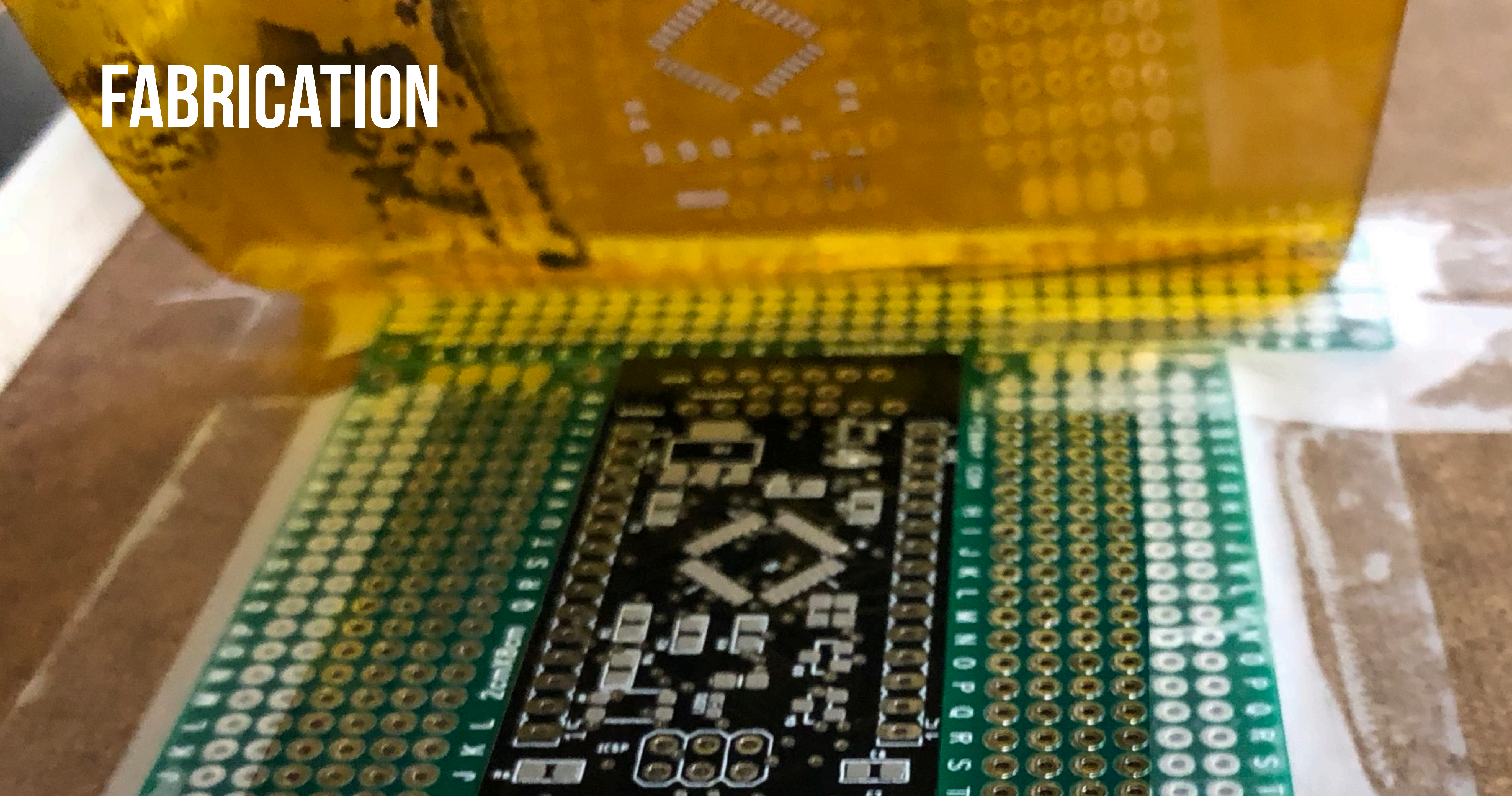






After placing over 32 components on the PCB, components were routed in a manner that would reduce crosstalk while also reducing thermal interference to the BME 280. Considering this chip is prone to self-heating, to dissipate heat, I had two options: ask the manufacturer to laser drill thermal vias under the chip's footprint, or increase the size of the solder pads. In an effort to reduce cost, I chose the latter. To reduce the production cost even further, I chose HASL (pb free) over ENIG surface treatment. By negotiating with overseas vendors, the cost of each PCB was under $35.

FABRICATION

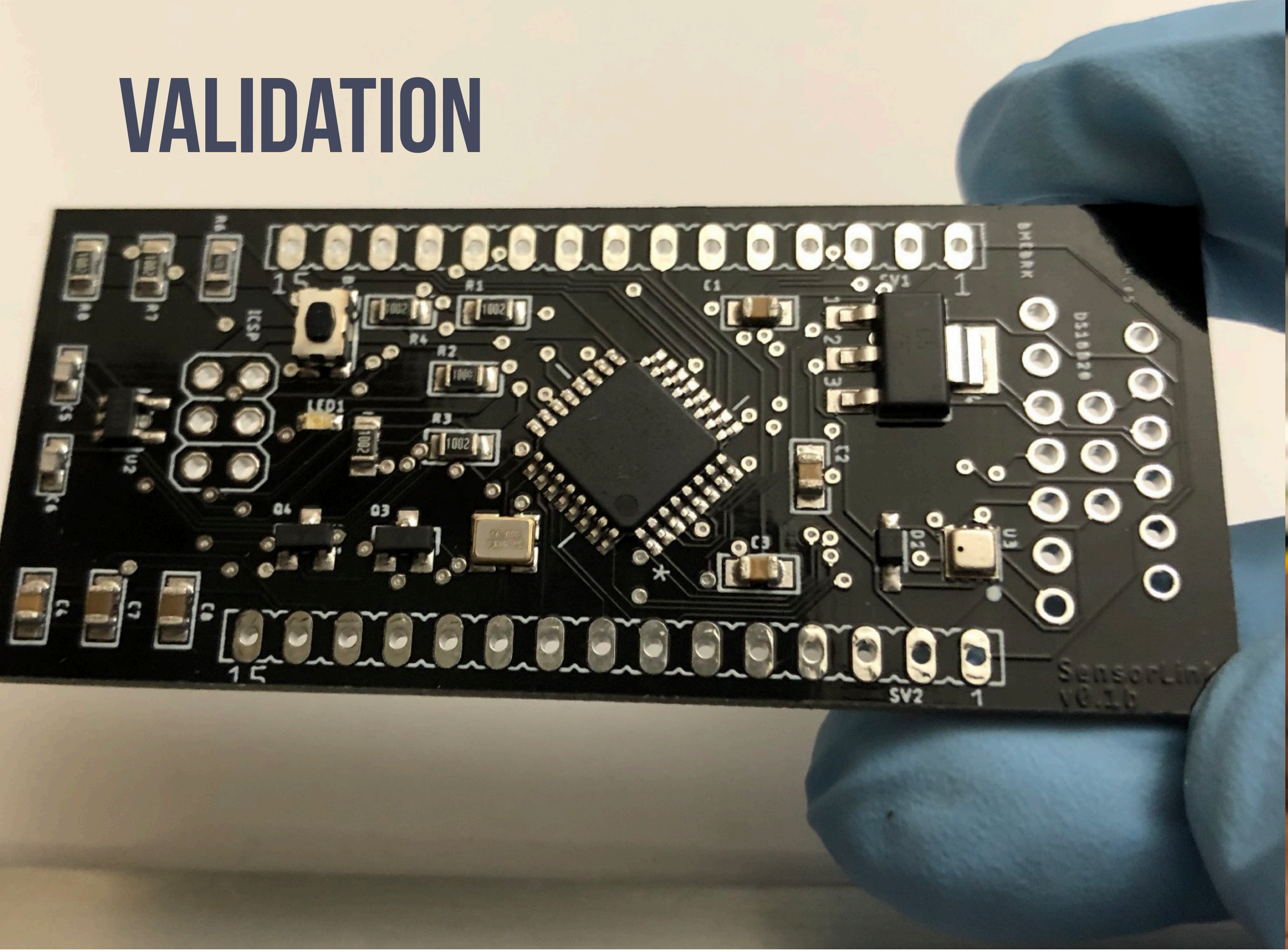


Due to the number of small surface mount components on the board. It was not possible to hand solder contacts without having bridged pins. A custom laser-cut polyimide solder paste stencil was used to uniformly apply paste for reflow soldering.

FABRICATION

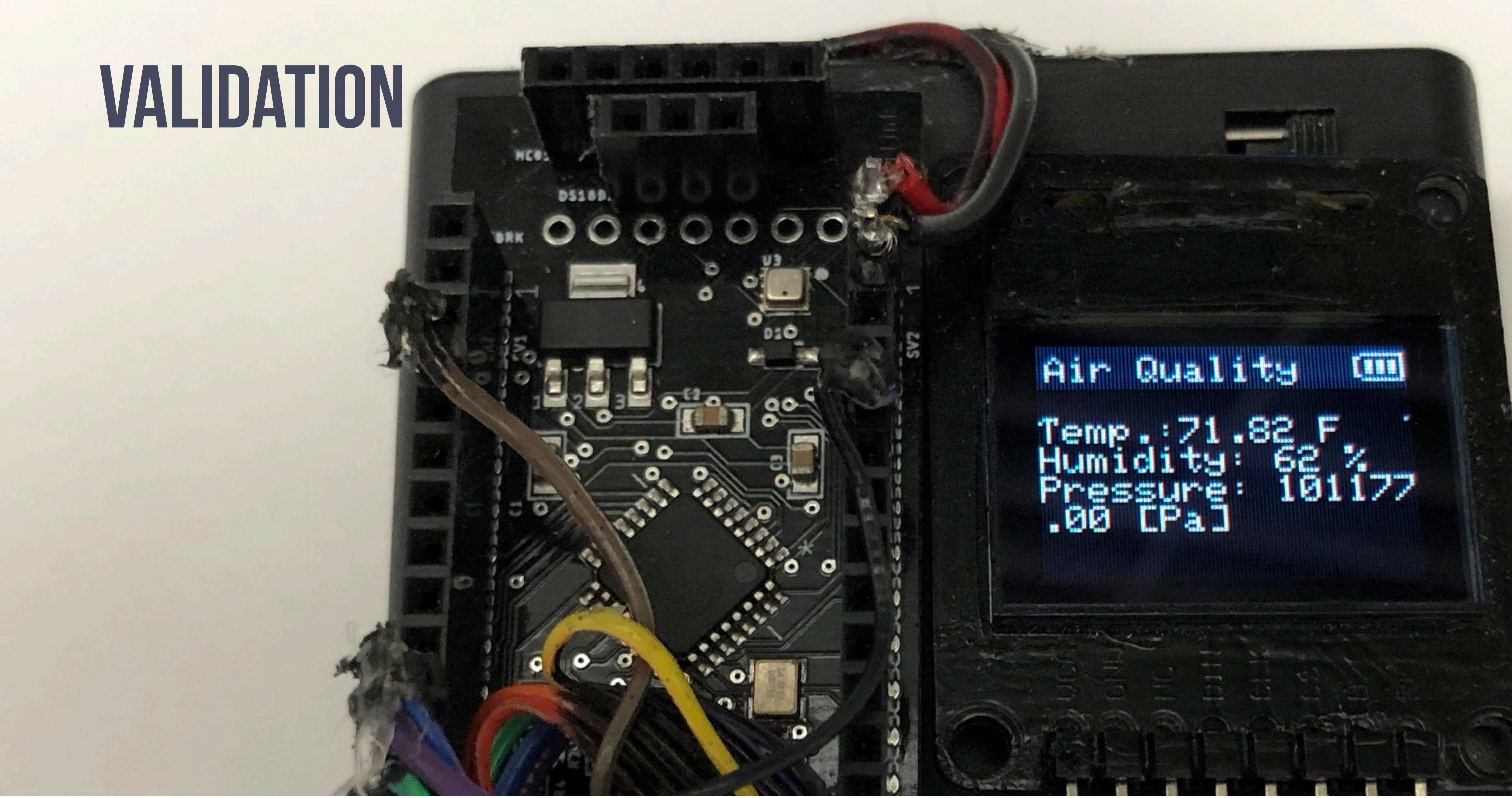
As an experiment, instead of using a conventional reflow oven, I modified a toaster oven to heat the boards to the correct solder profile for the components. A peak reflow temperature of 395 °F was achieved, following a cooling period to reduce thermal stress on sensitive components.

VALIDATION



Fresh out of the oven, SensorLink was ready for its first test: flashing a bootloader via its ICSP pins. Header pins were routed to allow individual testing of microcontroller pins. Breakout pins were routed for independent evaluation of the sensors, in case the board didn't boot.

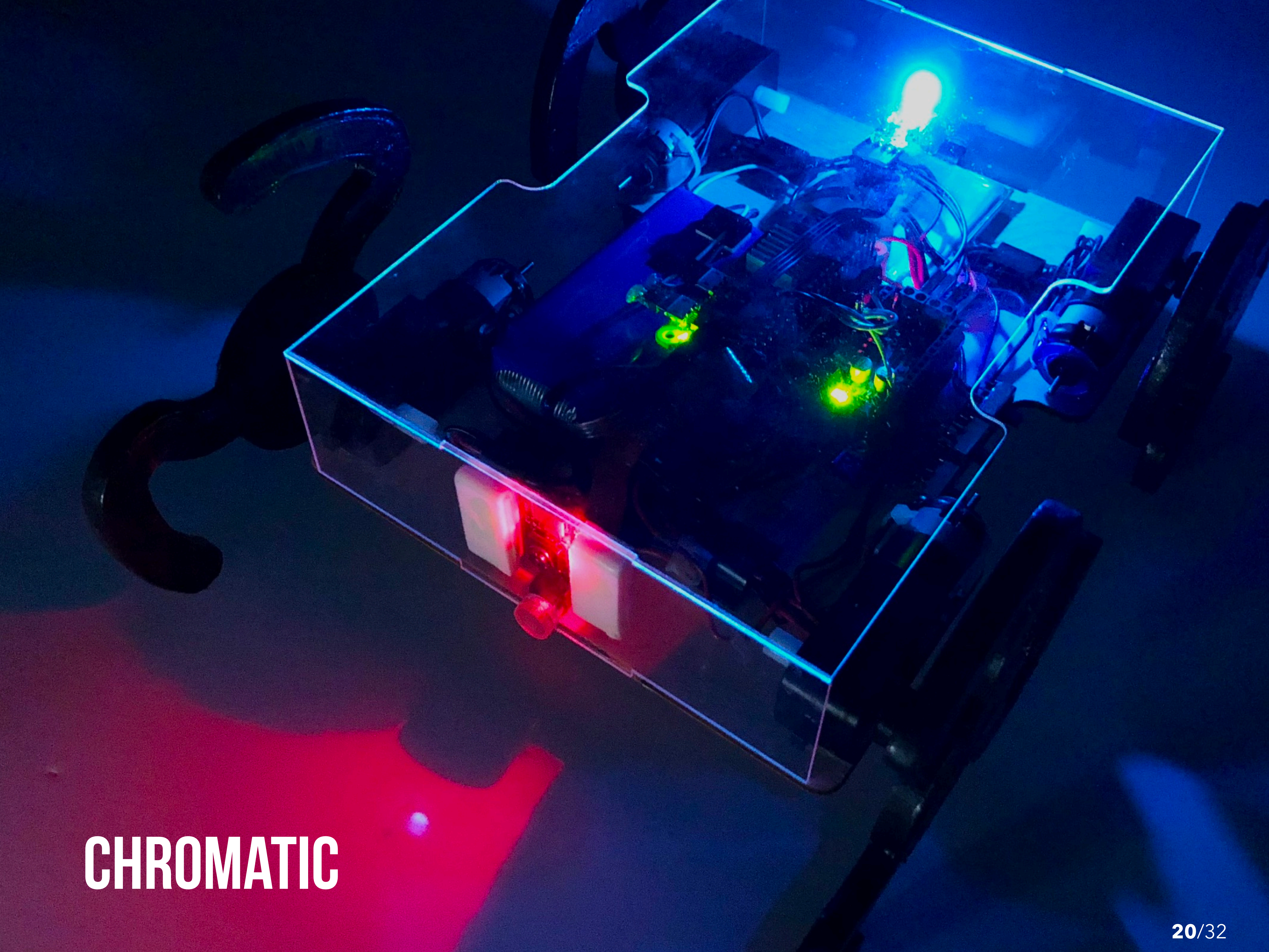
VALIDATION



To evaluate the performance of the components on the board, custom firmware was developed to read battery levels, temperature, air-pressure, and humidity. Results of the tests were printed on an RGB OLED display. Drivers were later modified to compensate for sensor reading offsets.

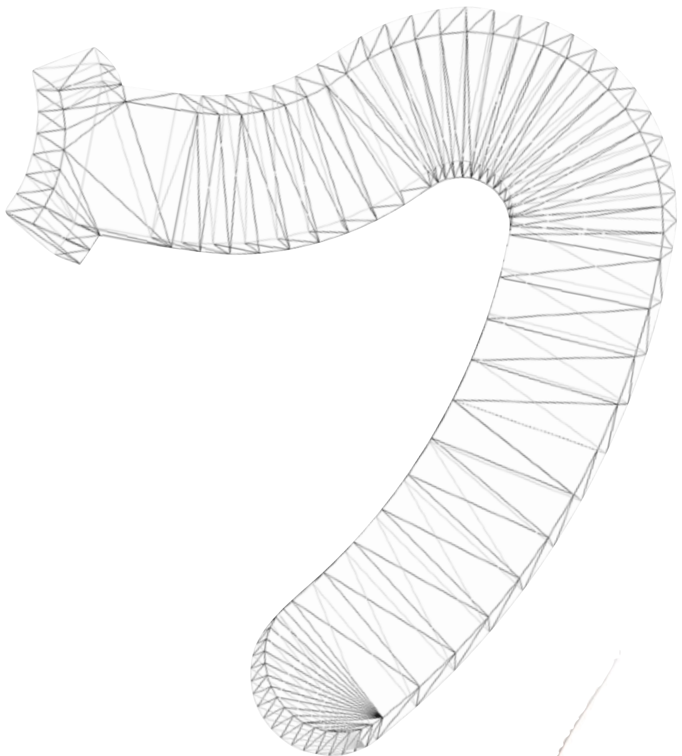
PAIRING

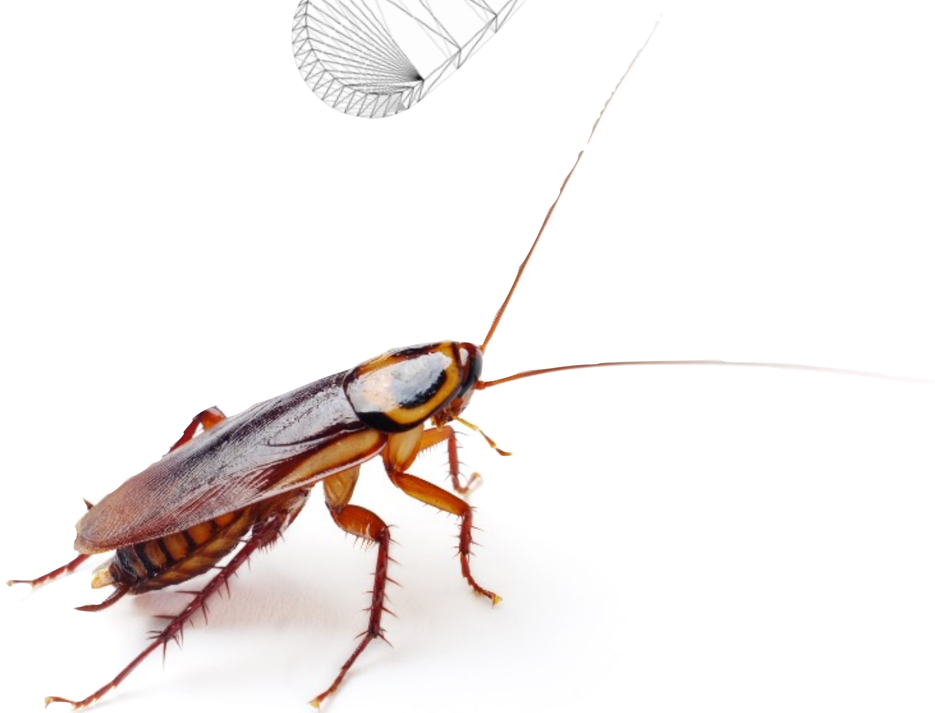
After successfully reverse engineering the ecobee wireless communication protocol and implementing it on the board, the ecobee thermostat now recognized and paired with SensorLink via a Bluetooth module. Instead of merely displaying the humidity at the base station, the thermostat now displays an average of all the humidities across the rooms.



CHROMATIC

BACKGROUND



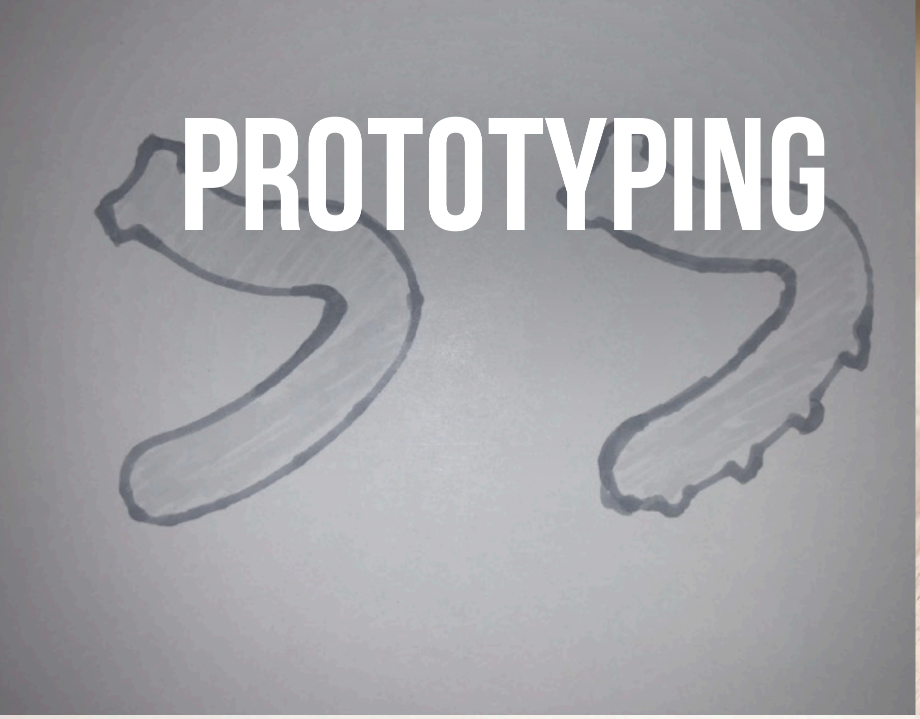
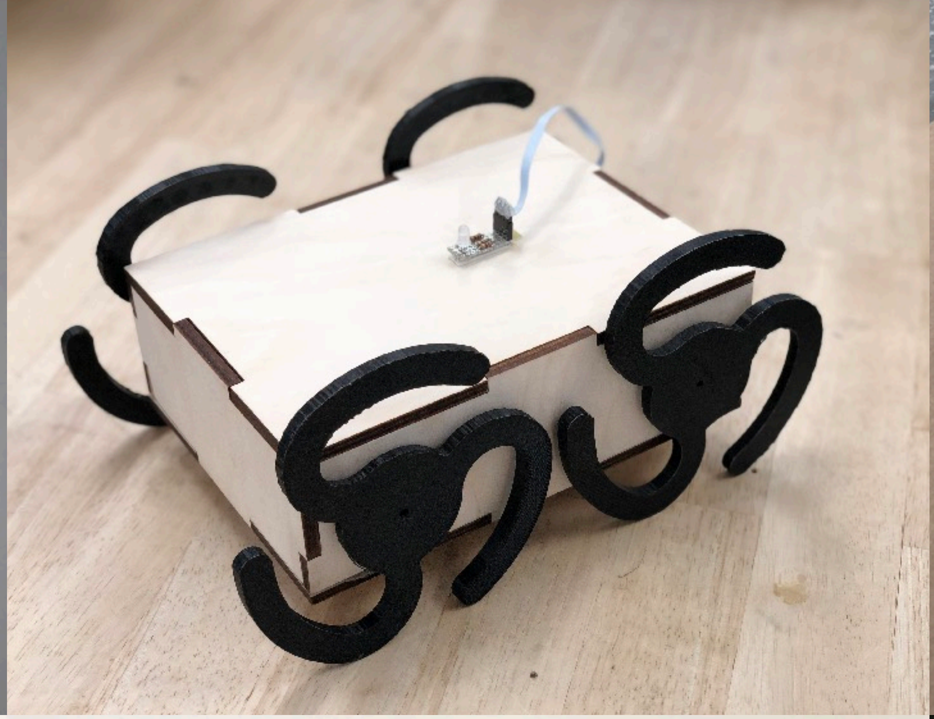


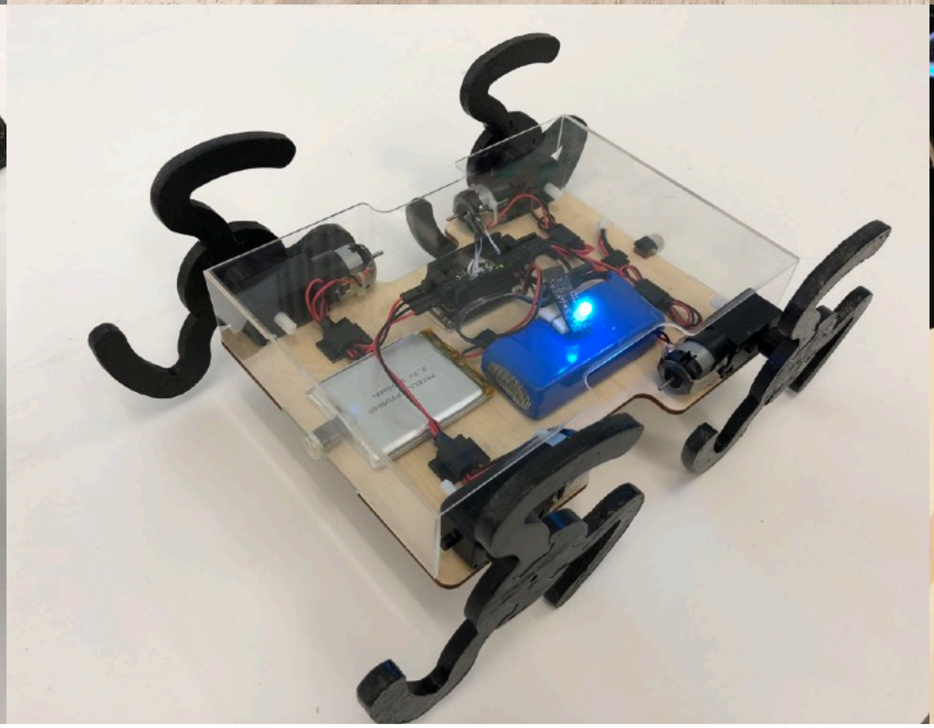
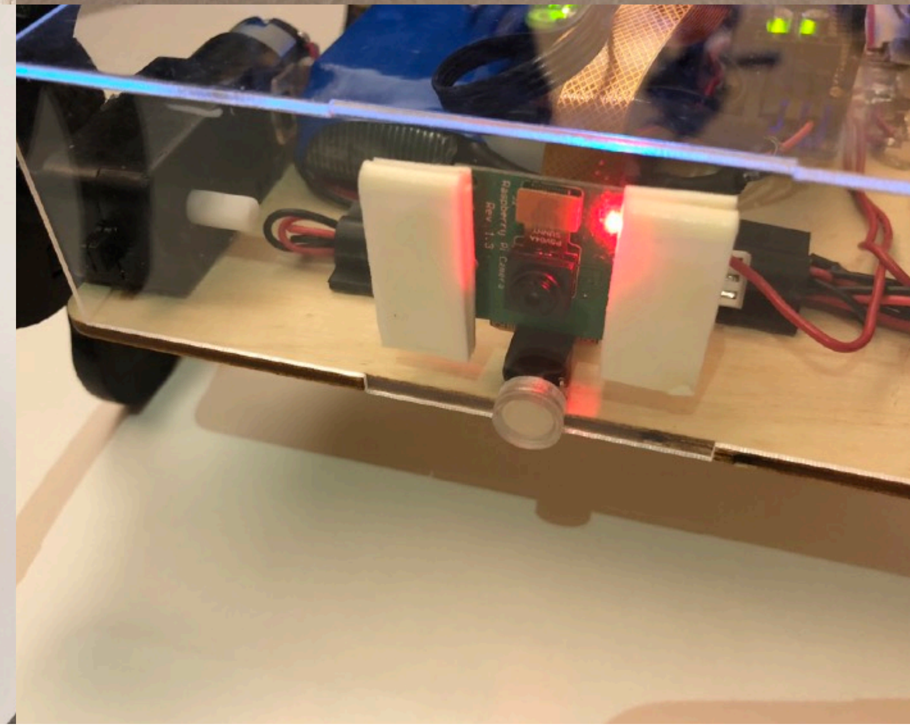
Natural disasters pose difficult problems for first responders. Displaced structures and debris make it exceptionally changing for search and rescue teams to locate missing individuals.

Nature is full of solutions to many design problems. Millions of years of evolution have led to optimized designs which perform in the most challenging environments.

Taking cues from insect motion, would it be possible to design a vehicle propulsion system that doesn't use wheels or tank belts that can traverse obstacles?

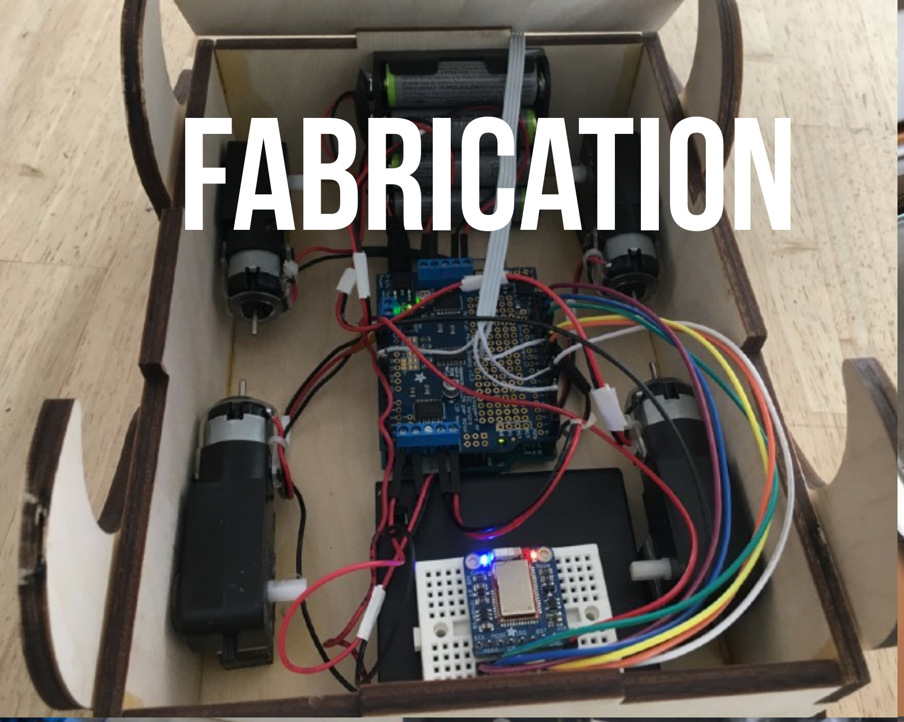
PROTOTYPING

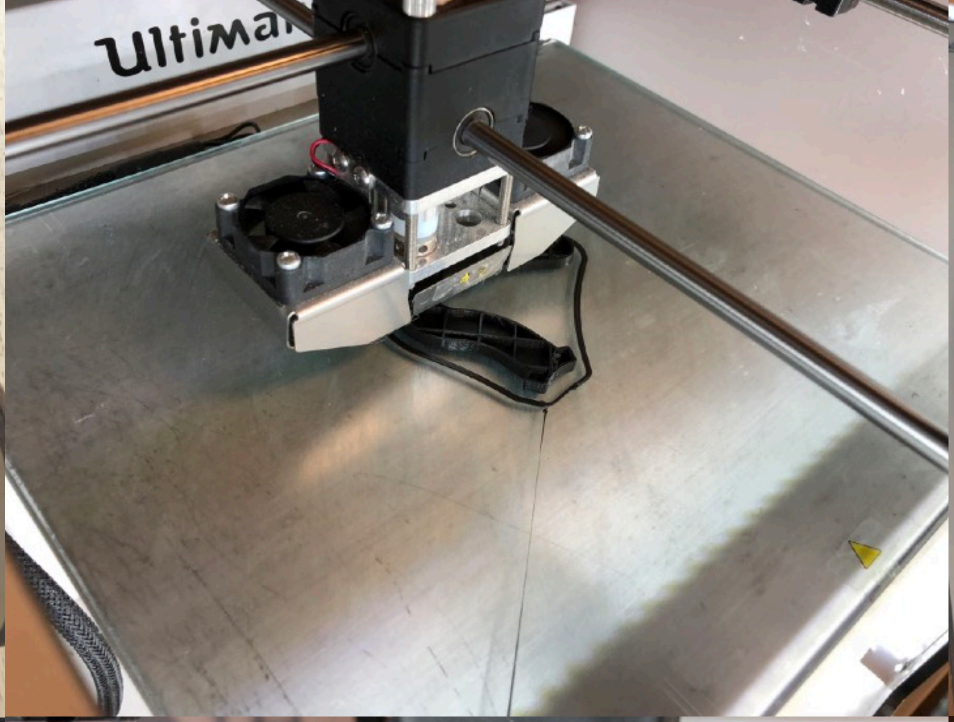



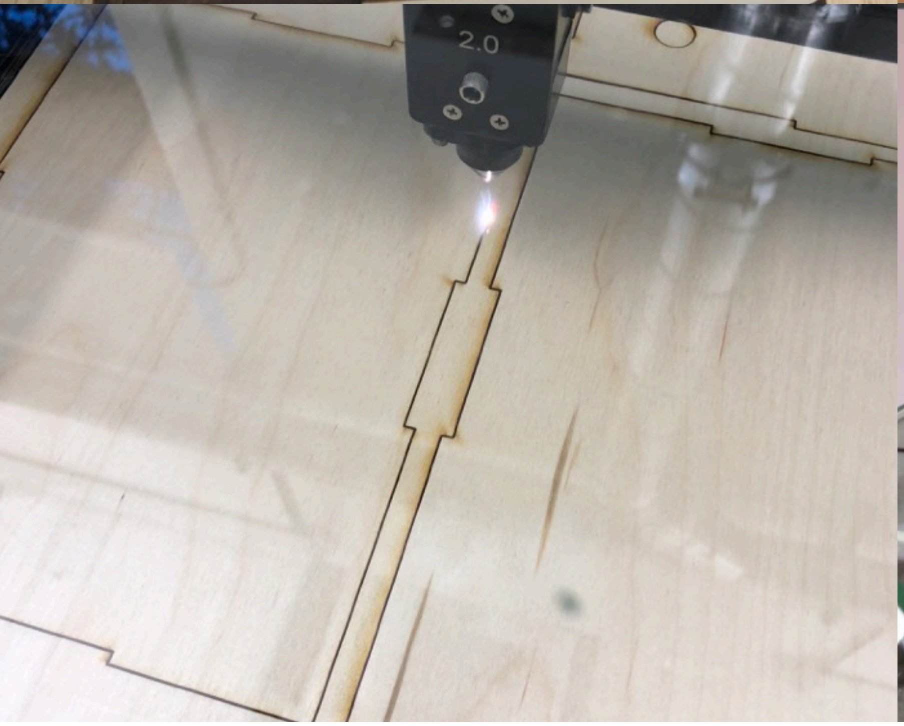




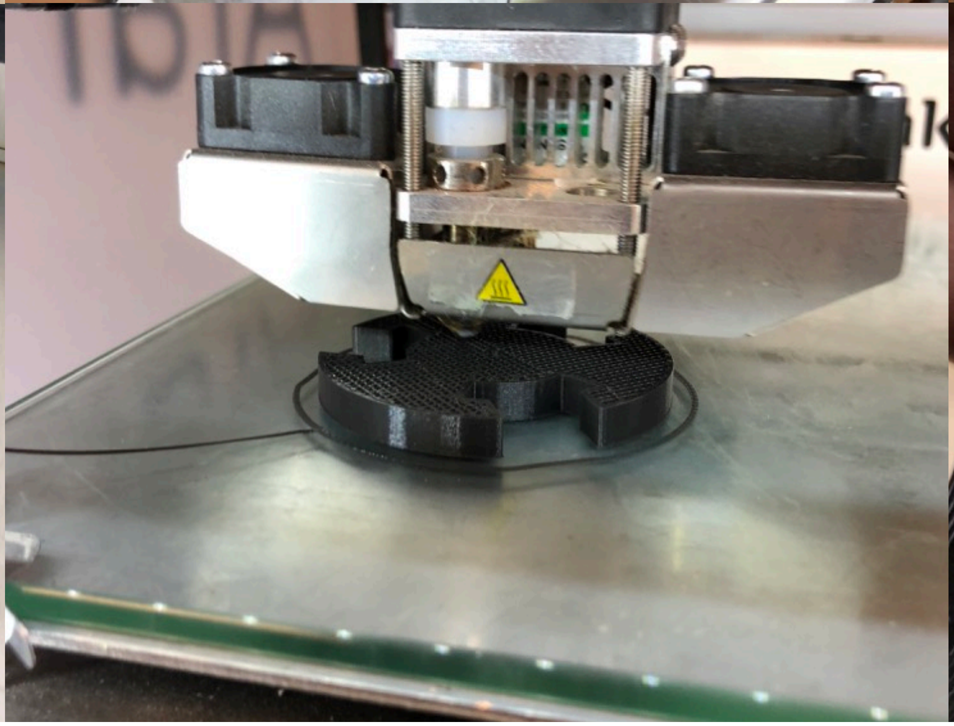
Rapid prototyping and a rapid evaluation of concepts was necessary. The dynamics of the bio-inspired whegs required four iterations to perfect. A modular hub with swappable whegs was created to assist in evaluating the traction and other performance characteristics of the propulsion system. The chassis evolved from birch plywood into a slim light-weight acrylic enclosure.

FABRICATION



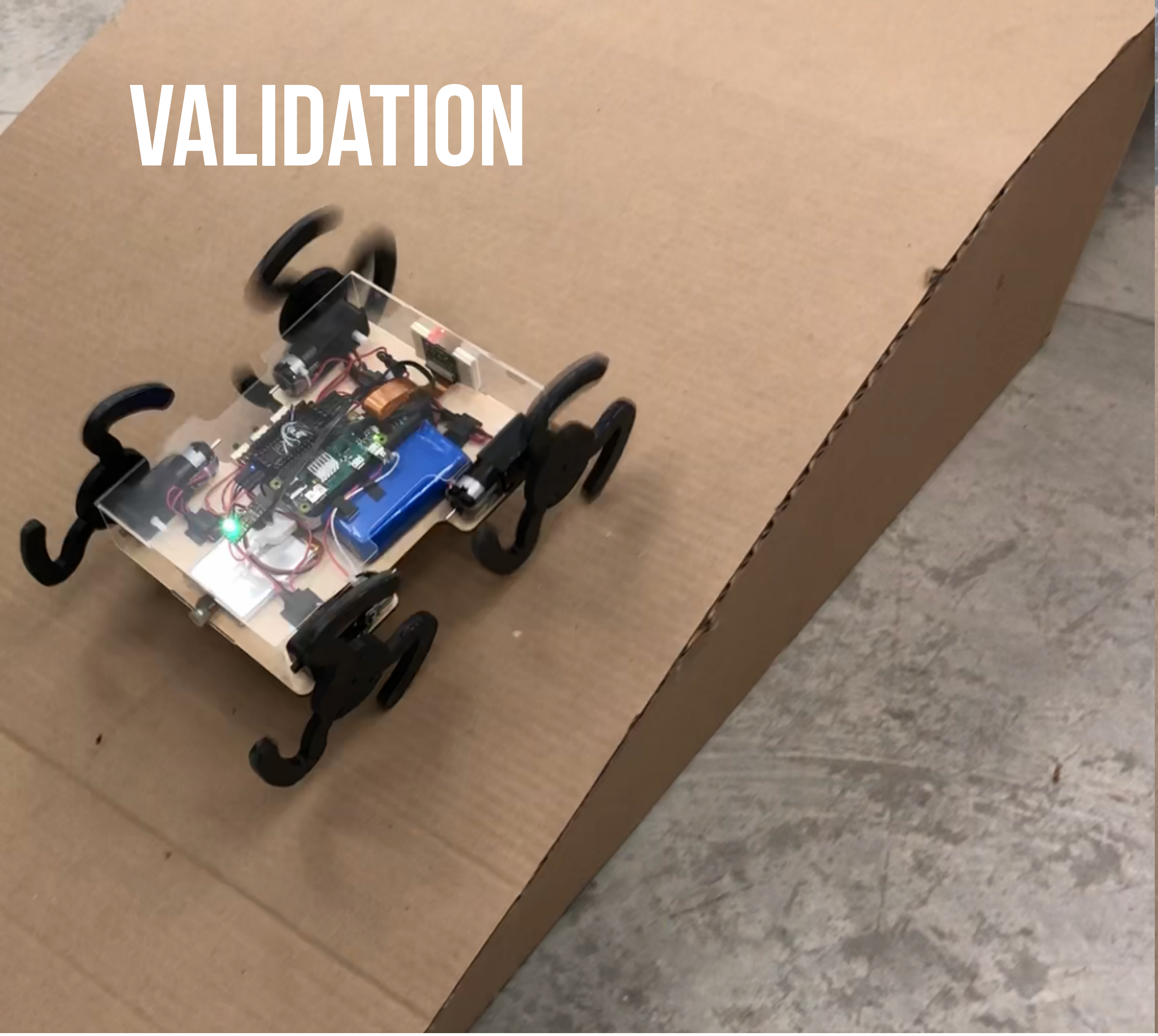


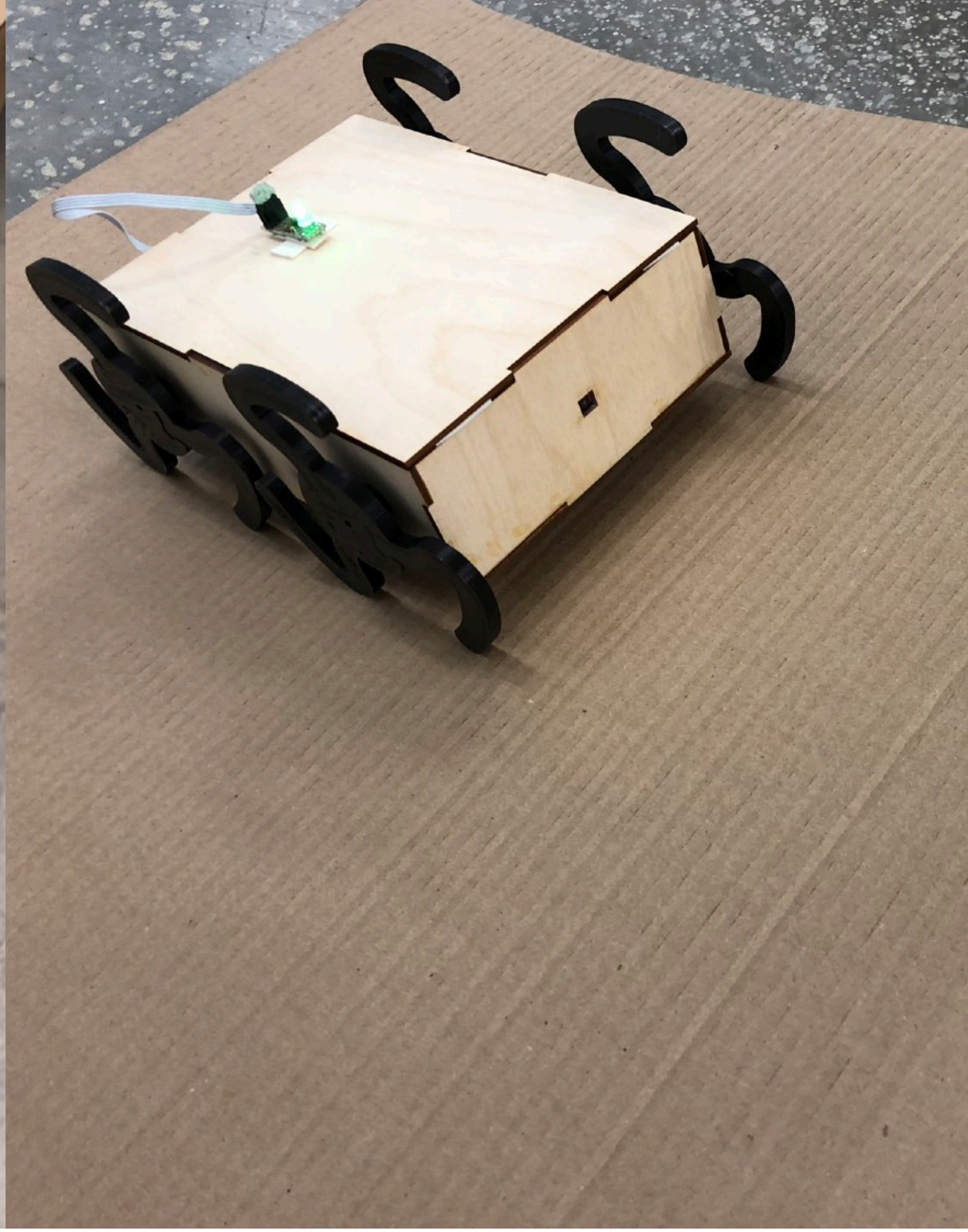




A combination of additive and subtractive manufacturing techniques were employed. The enclosure was laser-cut and the propulsion system was 3D printed. To improve traction, the whegs were coated with a rubberizing compound.

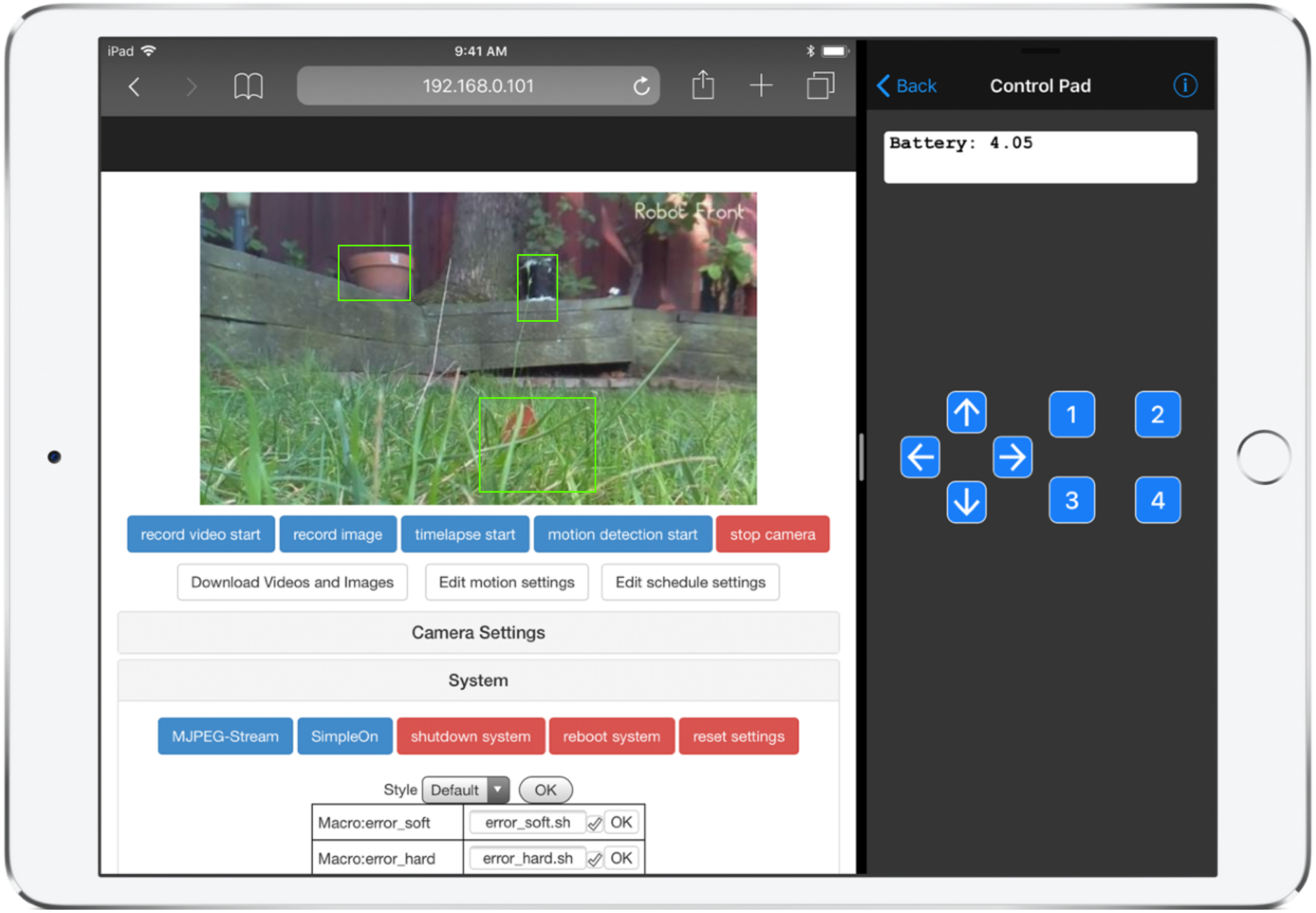
VALIDATION

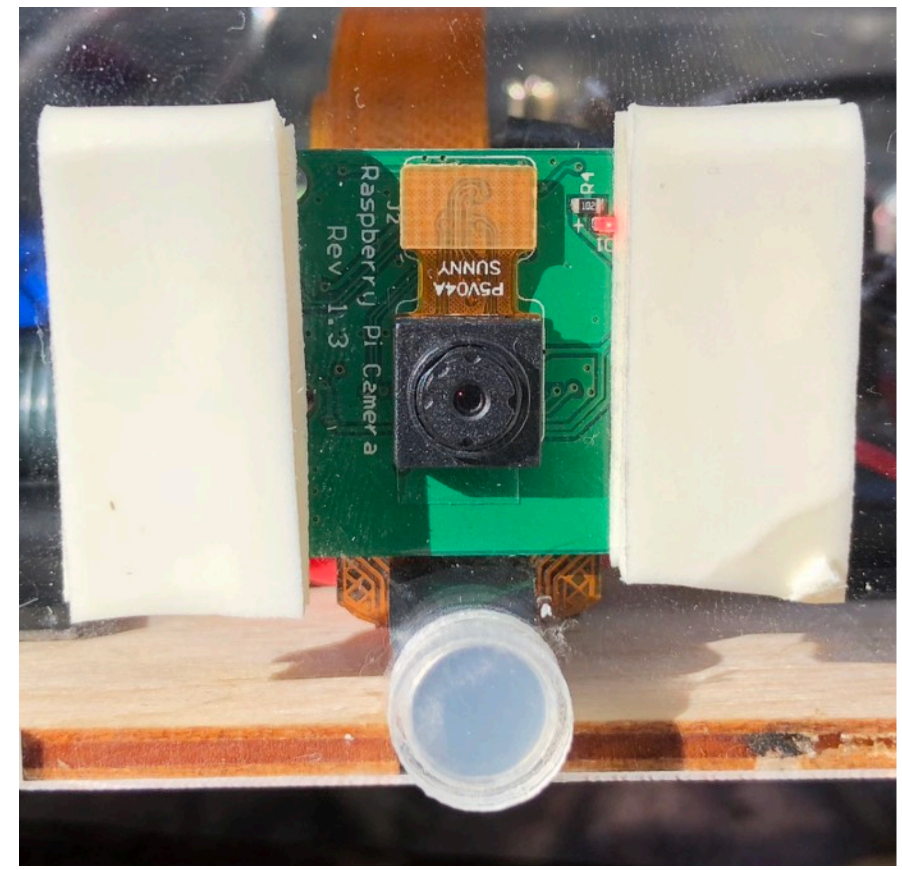




To validate the designs before final production, vehicle prototypes were subjected to curved ramps and driven around obstacles which required sharp turns. Insights from testing guided the design directions of future prototypes.

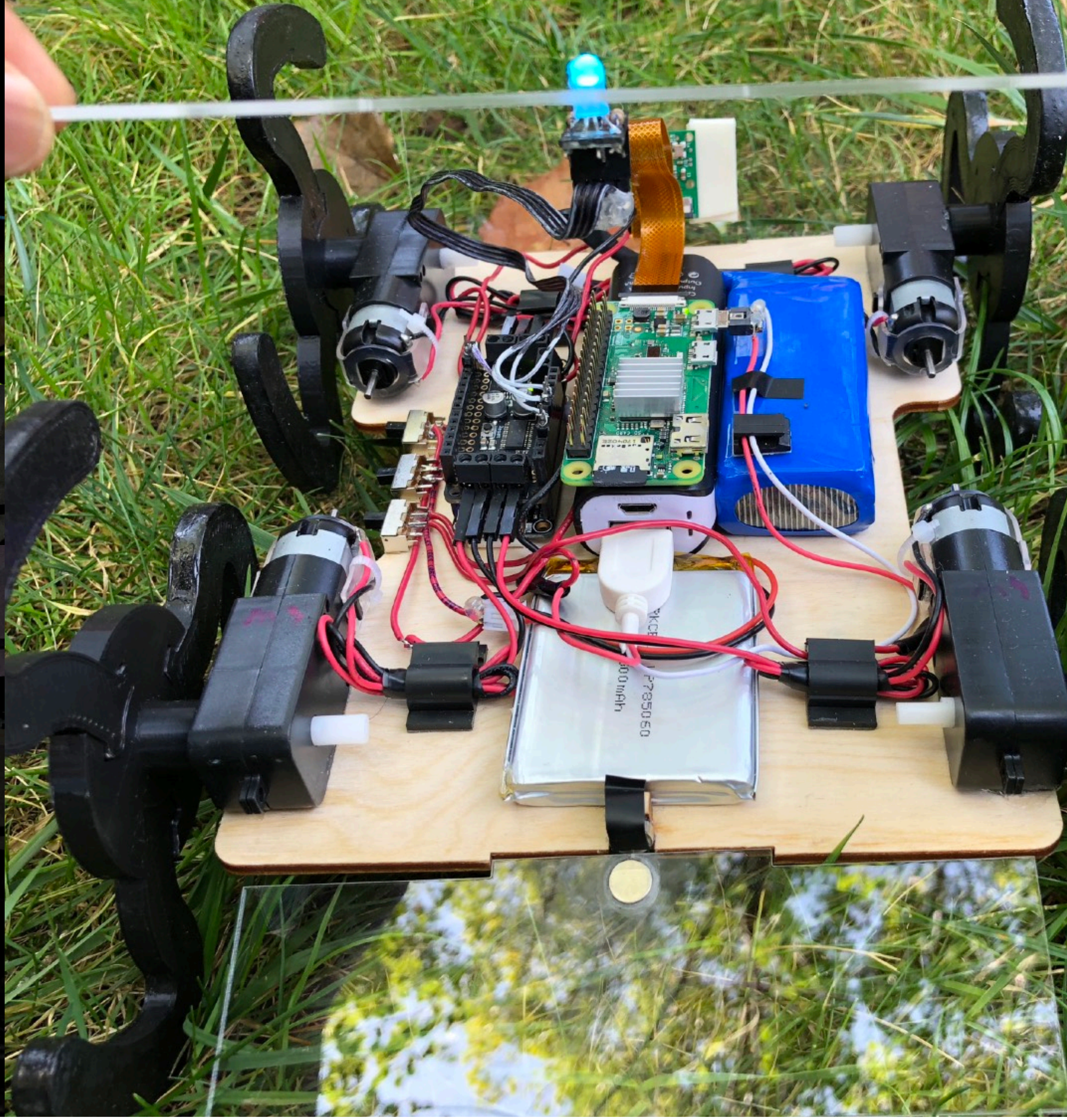
ENHANCEMENTS





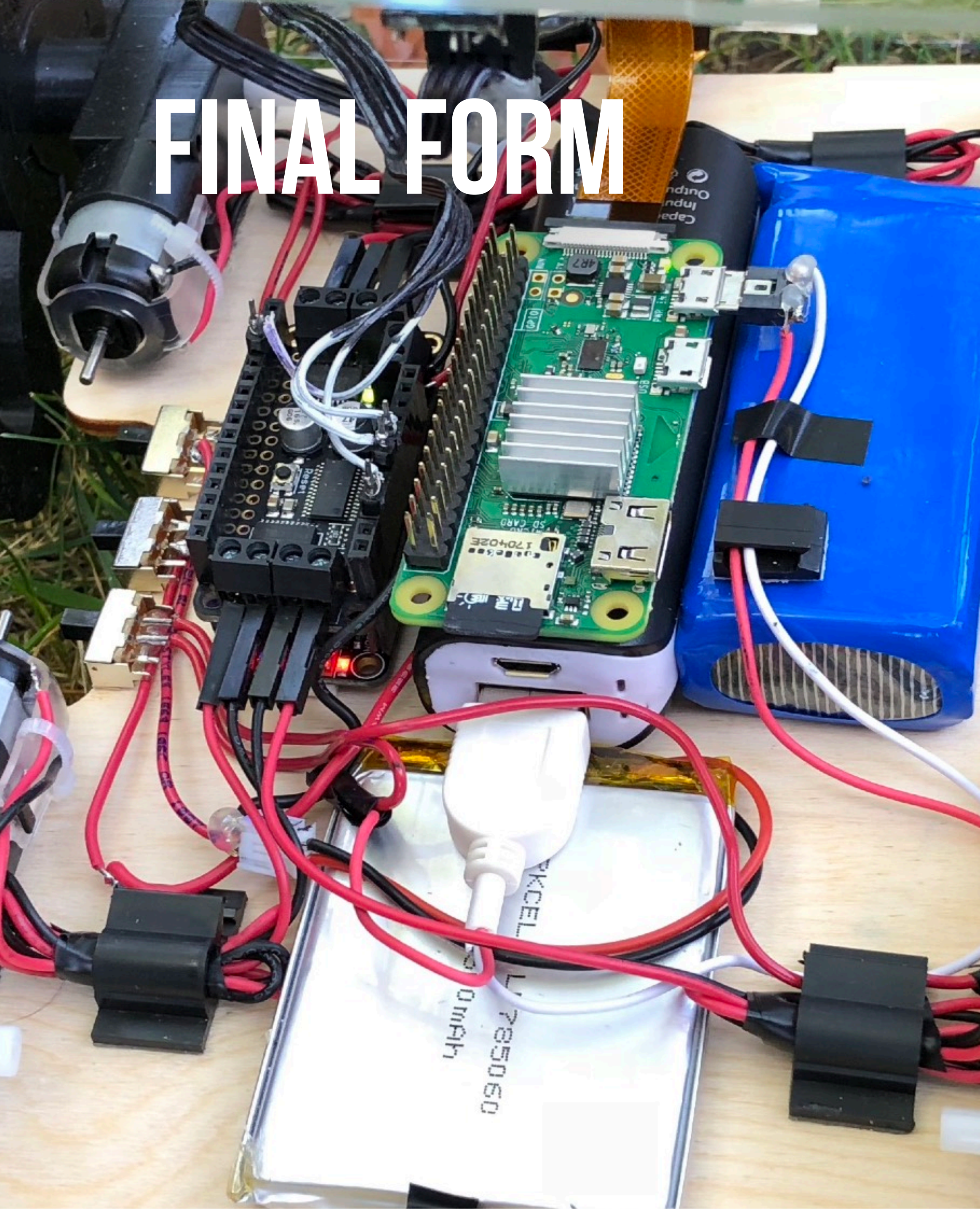
Incorporating a 5 megapixel camera, a low latency video server powered by a Raspberry Pi, and a Bluetooth LE controller, Chromatic can be remotely tele-operated without being in the driver's field of view. To ease remote operation even further, Chromatic's vision subsystem detects potential obstacles in real-time.

ENHANCEMENTS

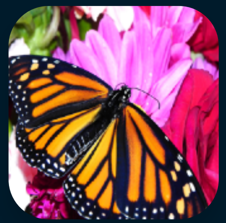


Chromatic's namesake comes from its visual feedback system. An RGB LED located at the rear of the vehicle changes color depending on the direction it travels. Chromatic's lightweight enclosure, secured by neodymium magnets, opens for easy access to the electronics.

FINAL FORM

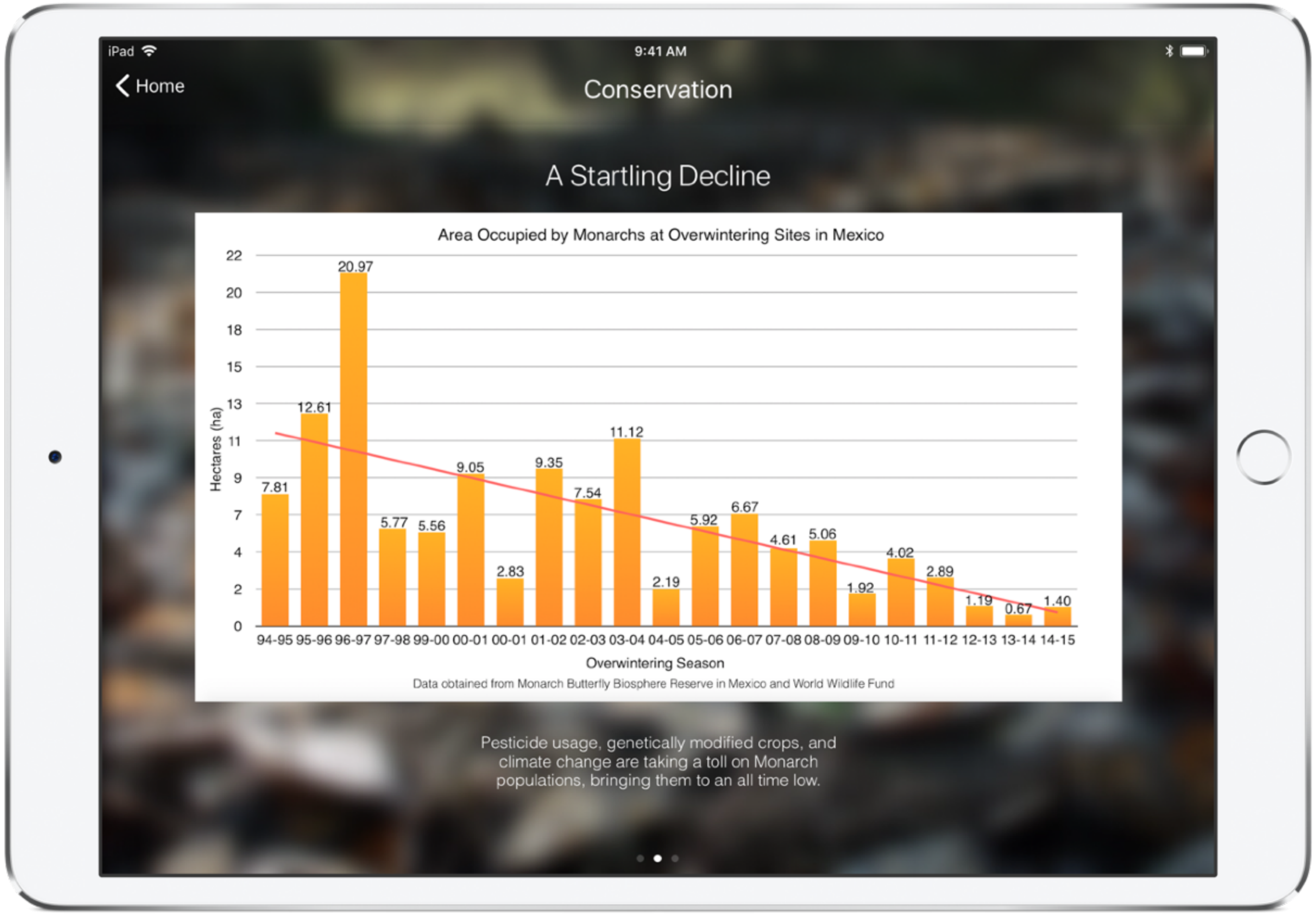


Featuring three different subsystems: vision, bluetooth communications, and motor power distribution, Chromatic is ready to scale obstacles with ease.



MONARCH APP

BACKGROUND



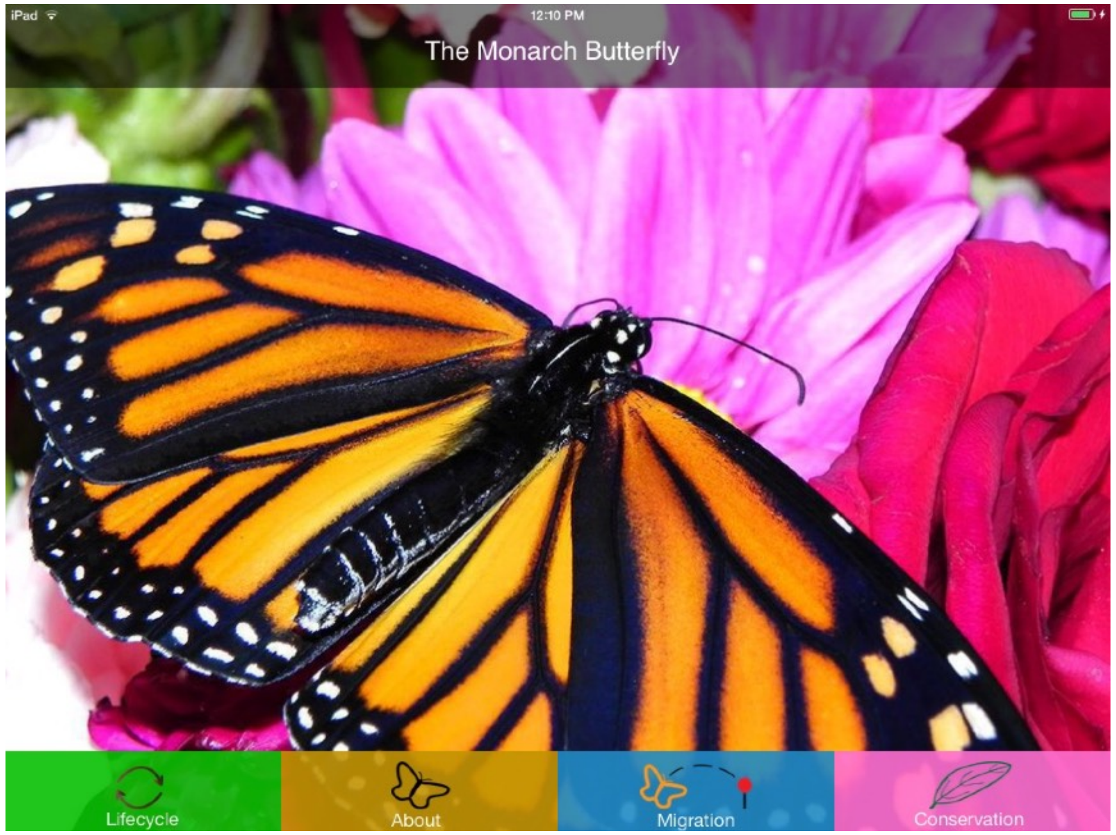
Monarchs are a species under threat.

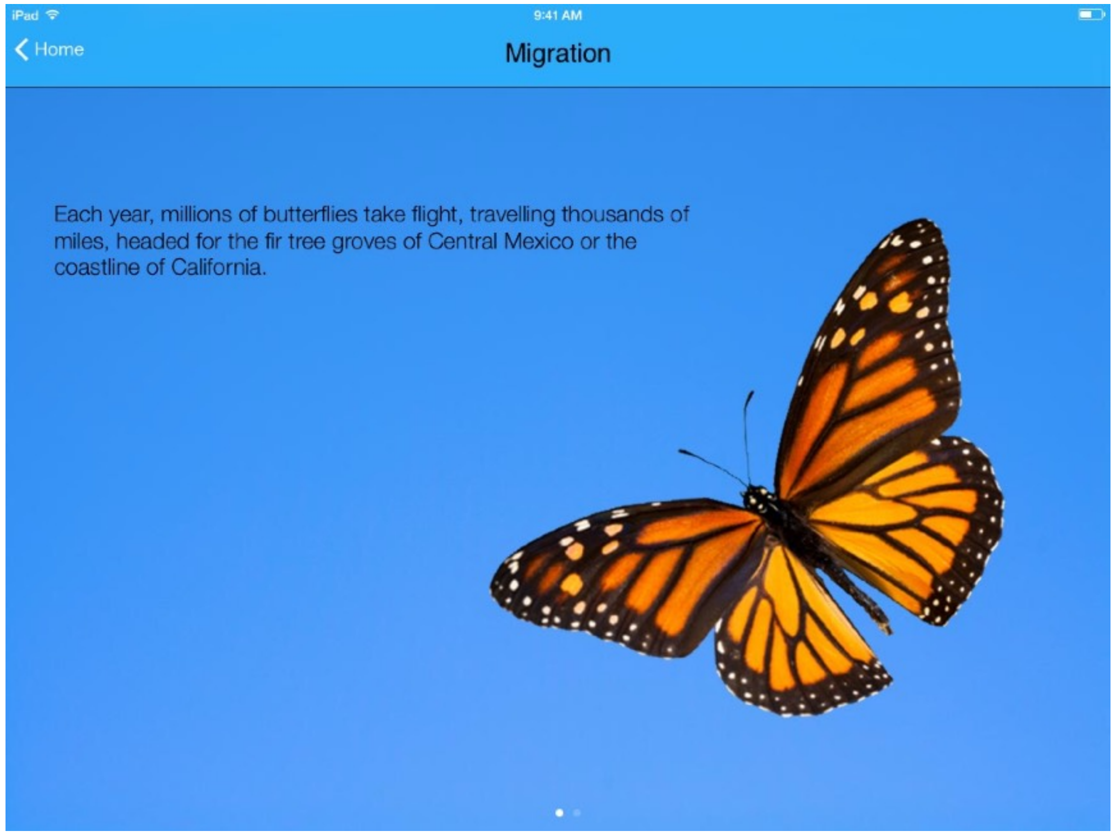
Human activities coupled with a changing climate have resulted in a steep decline of the butterfly's population.

In an effort to raise awareness about the issue, I developed an educational iPad app.

Featuring original photography, Monarch App illustrates the life history and the remarkable migration of the butterflies with the swipe of a finger.

OLD DESIGN

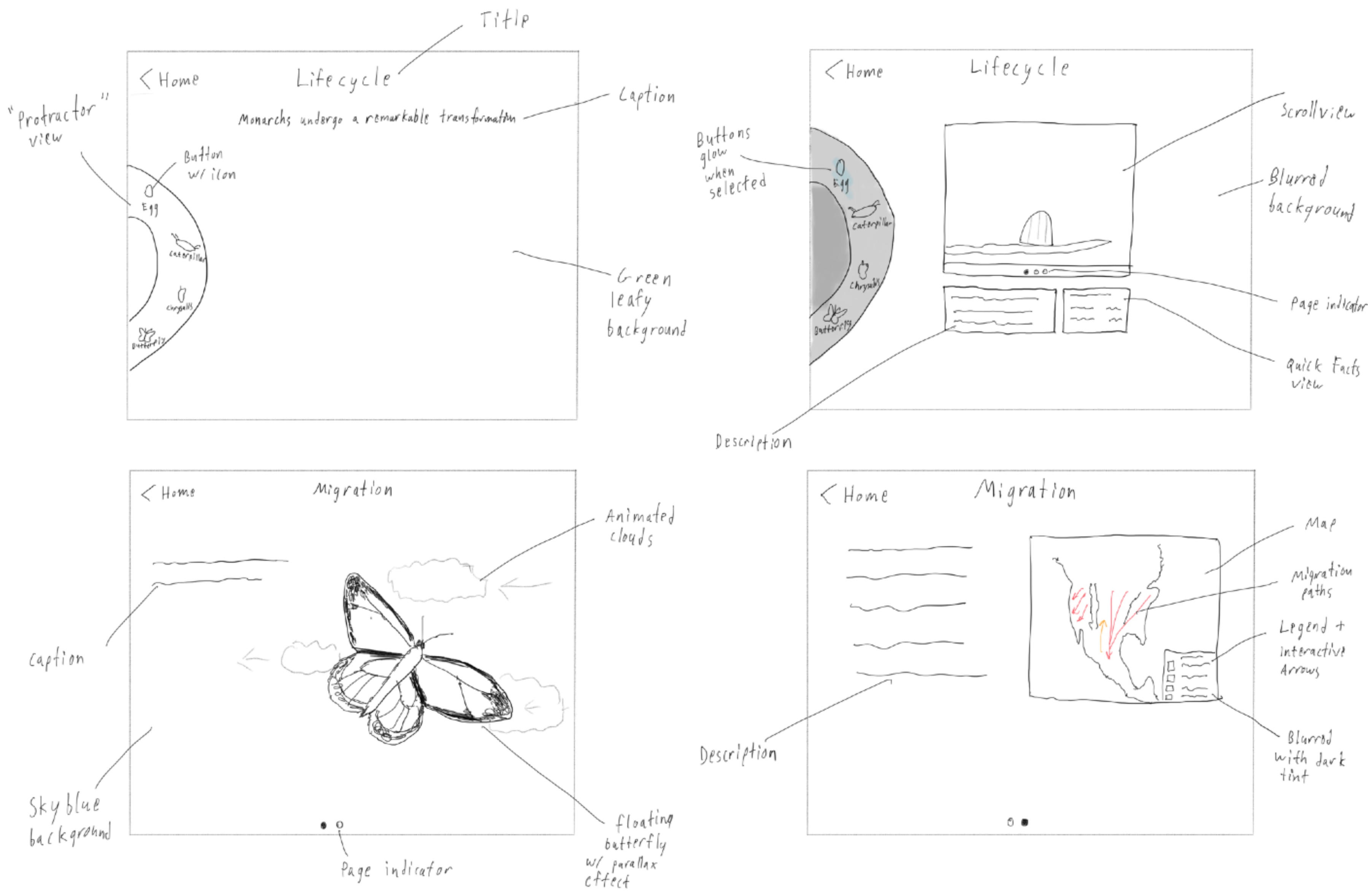




The metaphor of a custom tab bar at the bottom of the home screen, provided false affordance to users who felt that the bar would persist throughout the app's screens.

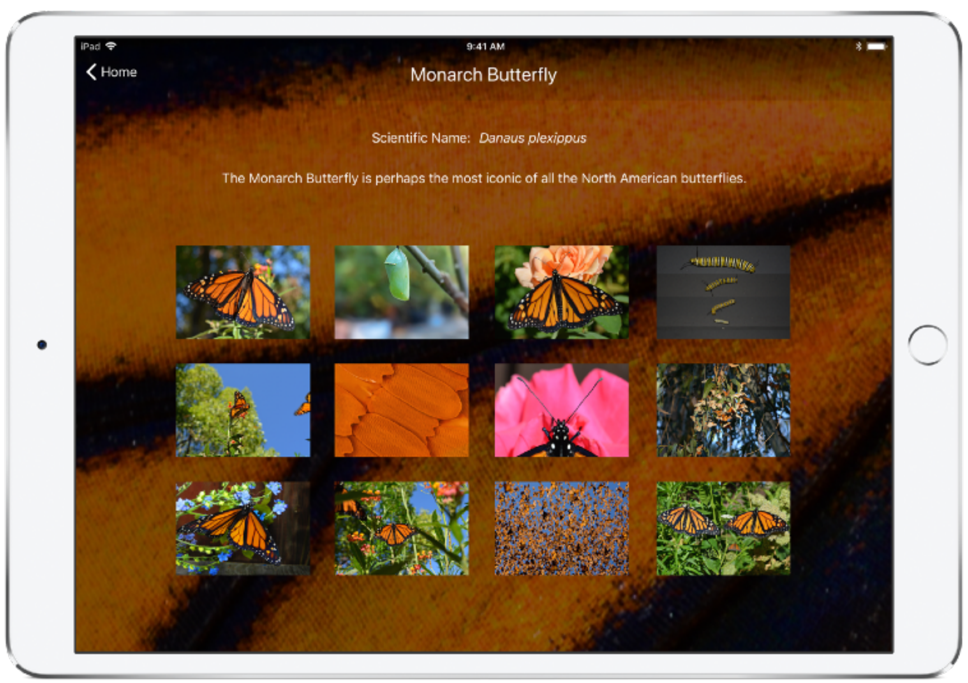
After observing users and getting feedback at WWDC 2014, I chose to redesign the app from ground-up to create a more interactive experience.

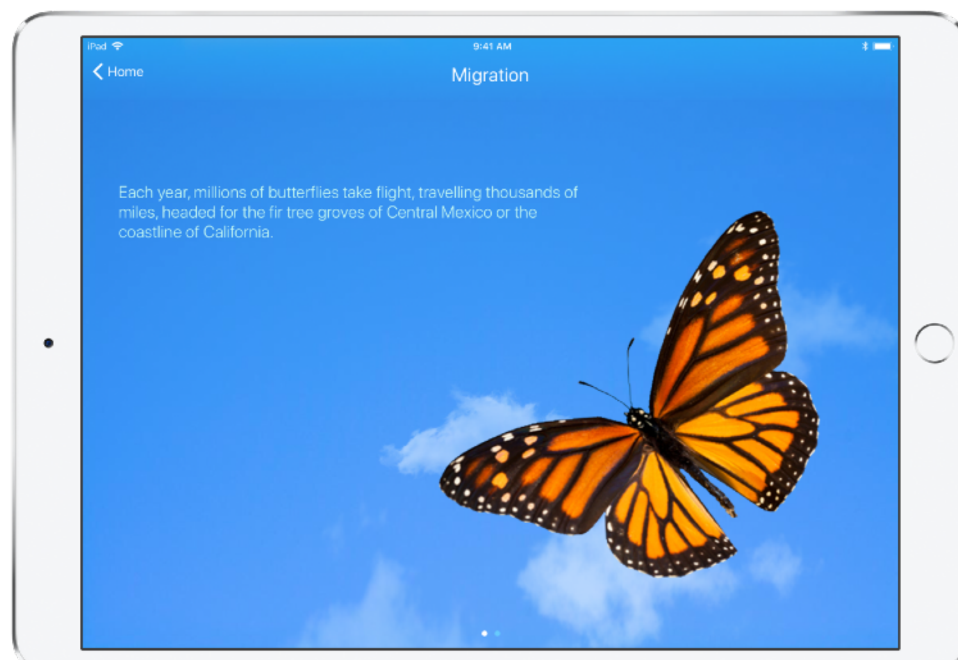
REDESIGN



After sketching a few new screens, users were invited to tap on the icons. Observing them interacting with low-fidelity prototypes produced enough insights into their behavior to develop a better user experience. Before investing in coding, interactive app prototypes where made in Keynote to understand how the users would respond to animations.

NEW DESIGN





Through the use of motion from accelerometers in parallax effects and through the use of extensive blurs, Monarch App's new design creates a sense of hierarchy which immerses its users within the content.